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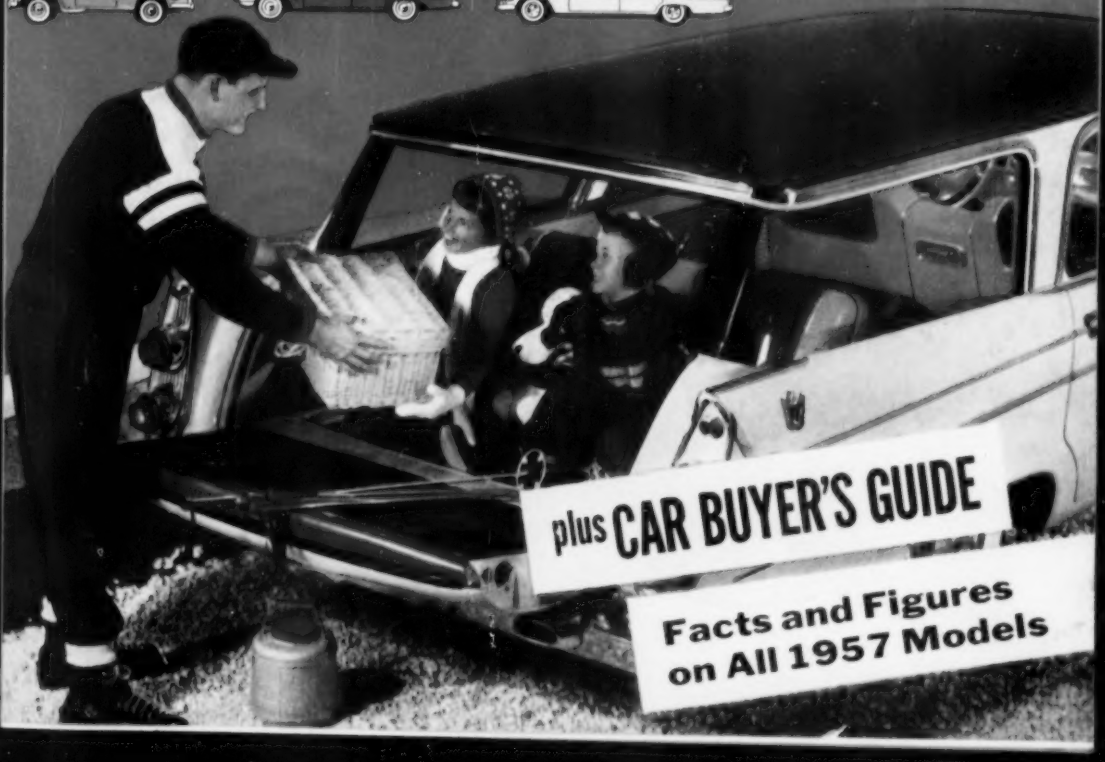

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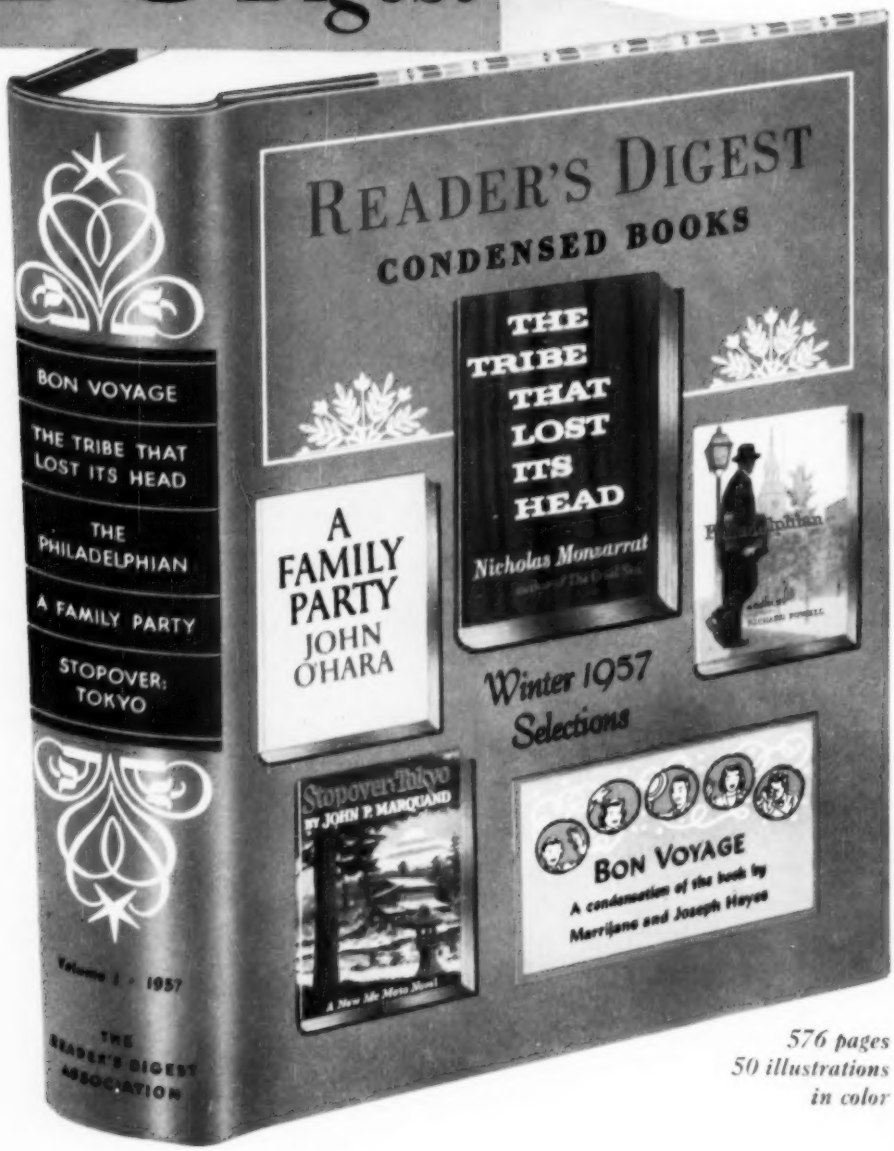

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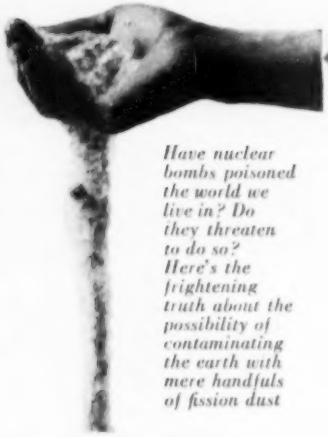
Popular Science Monthly

February, 1957

A backward look at a decade of dramatic change—from the bulging, underpowered car of '46 to the sleek new job on the sales floor



Have nuclear bombs poisoned the world we live in? Do they threaten to do so? Here's the frightening truth about the possibility of contaminating the earth with mere handfuls of fission dust

AUTOMOBILE NEWS

Big Boom in Detroit: Station Wagons · 104
Color Photos of New Station Wagons · 105
The Cars We Bought: '46-'56 · 113
The Cars We'll Buy: '57-'67 · 120
Facts & Figures on All 1957 Models · 125

WORLD OF SCIENCE AND INDUSTRY

Our Push-Button A-Bomb Is Ready · 99
How Abe Lincoln Modernized War · 130
Running the World's Fastest Railroad · 134
His Cartoons Save Our Pilots' Lives · 156
Things You Never Knew About Springs · 160
Will Bomb Dust Endanger Your Health? · 163
Copter Fire Engine Beats the Blaze · 175

THE NEWS IN PICTURES

Atomic Sub's Hull Assembled in Slices · 139
An Air Armada Poses for Its Picture · 140
Flashlight Shines: No Battery or Bulb · 142
Gatling Gun Makes Jet Fastest-Firing · 145
Atomic Furnace Previewed in Plastic · 147
Rear-View TV Gives Car Hindsight · 148
Prop Takes This Auto Aloft · 150
B-52 Bombardier Takes Over Bomb Run · 152
Boy Builds Rocket in Basement · 153

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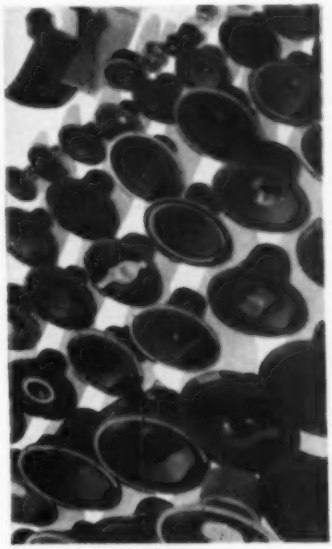
SPECIAL FEATURES

Now You Can Trade In Your House · 168
Gus Skids into Trouble · 178
How to Choose the Right Loudspeaker · 196
When TV Transformers Play Tricks · 205
How I Have Fun with Electronic Flash · 209



Woofers to squawkers to tweeters—PS rounds up 129 popular hi-fi speakers. With complete specs, of course

FOR HOME AND SHOP

Wiring Your Home for Sound · 184
Seven Tips on Making Cabinets · 188
How to Patch Plaster · 192
Cork Walls: A Paste-and-Scissors Job · 202
Seven Uses for Thread Spools · 212
He Dunks Typewriters in the Sink · 213
New Gun Slings Out Paint · 222
Sliding-Door Trick Makes More Space · 223
Decorative Rack Keeps Mail Sorted · 242
Portable Blower Squirts Insulation · 246

WHAT'S NEW IN . . .

Keeping the Home Shipshape · 16
Ideas from the Inventors · 172
Aids to Modern Living · 176
Hints from the Model Garage · 182
Handyman Products · 204
Tools for Your Shop · 220
Car Accessories · 221

EVERY MONTH . . .

PS Readers Talk Back · 4
I'd Like to See Them Make · 12
Prize Projects by PS Readers · 14
You Ought to Know · 19
Wordless Workshop · 190
PS Shop Notebook · 218
Short Cuts and Tips · 225

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PS Readers

TALK BACK

Safety Car Finds Favor

YOUR article, "This Car Can Crash Without Hurting You," [Dec.] is excellent and should be seen by every motorist.

MACDONALD WOOD, M.D., Chairman, Safety Committee, Arizona State Medical Assn.

. . . I am enthused about the Cornell Safety Car and I hope enough public opinion can be aroused to make the auto manufacturers

build them. I'd pay up to 50 percent more to get all those safety features.

ALAN PIER, Philadelphia

Credit Where It's Due

THANK you for your article, "Fastest Sub Points Way to Undersea Liners" [Dec.].

We feel, however, that the article should have given credit to the Portsmouth Naval Shipyard for the design and construction of the Albacore as an experimental "true" submarine, i.e., a submersible that can surface, rather than a surface ship which can submerge.

ROLAND HINKLEY, Portsmouth Naval Shipyard Development Assn., N.H.

Pat on the Back for UNIVAC

I WOULD like to congratulate POPULAR SCIENCE and author Gardner Soule for presenting one of the most lucid explanations of the Univac compilation of the biblical concordance project [Nov.] that I have seen. I was with the Remington Rand Univac Division and I can fully appreciate the difficulties of explaining a complex problem of this nature to a lay audience.

ALVIN J. BOSGANG, New York City

A Tip on Circular-Saw Blades

WHEN it comes to circular-saw blades, it is my feeling that there is no substitute for quality. Recently I obtained, for the first time, a carbide-tipped blade which, in my experience, surpasses everything tried so far.

Mr. De Cristoforo's article ["Better Blades for the Circular Saw," Nov.] may leave the impression that *all* carbide-tipped blades are priced beyond the home shop. Actually those with fewer teeth don't cost much more than the best all-steel blades, and in the long run cost less by staying sharp longer.

B. F. WALING, Midland, Mich.

Wife Wins Family Light Feud

FOR years I have been righteously annoying my wife to turn off the lights when she leaves a room. Most of ours are fluorescent.

Along come you and Jack Foster ["Trouble-Shooting Fluorescent Lamps," Nov.] and say the less often you turn them on and off, the better.

Also along comes my inquisitive wife, and

now—"poof!" You have disrupted a running family fight and given the lady the upper hand.

MANNING M. MELTON, Bronx, N.Y.

An Answer—31 Years Later

A SMALL item in your "Letters" section headed "Model A Had Folding Shift, Too," re-

This man is a "security risk"!

Age, 29. Married. Two children. High school education. Active in local lodge, church, veterans' organization. Employed by large manufacturing concern. Earns $82 a week.

SOUNDS like an Average Joe. And he is. Too average! He's got a job. It pays fairly well. He's satisfied.

But here's the catch. With the right kind of training, this young man could be stepping into better jobs. He could be making $7-8000 a year. He could be cashing in on those spare-time hours he now wastes.

As it stands now, he's stuck in his job. Can't seem to make any headway. He's reluctant to try. So he just hangs on.

This man is a "Security Risk" to his wife and children.

His family probably will never enjoy the comforts, the prestige, the good living that could be theirs. If hard times come, they are almost sure to be hurt. For an Average Joe can't expect to compete with trained men when the chips are down.

A man like this would do well to start a planned program of self-improvement. In his spare time. In a field related to his interests and abilities. Right NOW!

One good way to start—a way proved by hundreds of thousands of once-Average Joes who are making good today—is to enroll for special training with a recognized correspondence school. One like I. C. S., the oldest and largest in the world.

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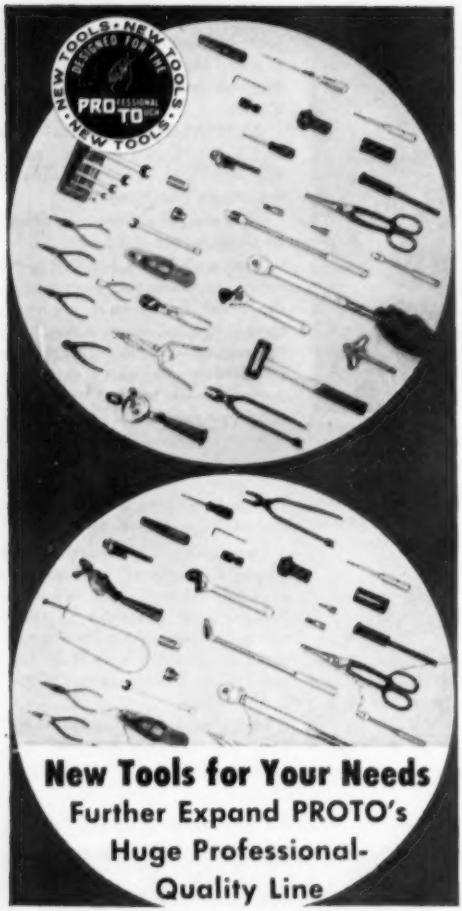

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minded me of a Chrysler "70" my people owned in 1926. This car also had a gearshift lever that folded or "parked away" from the top gear position . . . I often wondered whether it was an intentional feature.
NEYLE L. CORNISH, Wellington, New Zealand

The Chrysler people say it wasn't. They suggest that it was a "malfunction."

Give Parents Tickets, Too?

THIS is in reply to a letter in the November issue from a Mr. Koroskys concerning governing the top speed of an automobile to prevent misuse by one's son or daughter.

What Mr. Koroskys fails to realize is that if a father feels that his son or daughter is going to misuse the right of driving he has no business trusting them with the car. I think that the parent of a reckless young driver should be held responsible for his son's actions. If his son gets a ticket, he should get

one, too. If this were done, parents would be forced to make their sons and daughters drive properly or lose their own licenses.
HOWARD WHITE, Bronx, N.Y.

Measuring Fuel-Injection Vacuum

YOUR article on Chevrolet's fuel injection in November emphasized how much engine vacuum was used in the system controlling the amount of gas reaching the cylinders. However, I couldn't find any mention of how powerful this vacuum is. Can you compare it with anything common, like a vacuum cleaner?
RALPH LAKE, Berkeley, Calif.

The customary measurement for manifold vacuum in internal-combustion engines is the displacement of a column of mercury in a tube graduated in inches. The Chevrolet sys-

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I Trained These Men

"I have a regular job as a police captain and also have a good spare time Radio and Television service business. Just opened my new showrooms and shop."—C. W. LEWIS, Pensacola, Florida.

"I decided to quit my job and do TV work full time. I love my work and am doing all right. If fellows knew what a wonderful investment NRI is, they would not hesitate."—W. F. KLINE, Cincinnati, Ohio.

"Thanks to NRI, I operated a successful Radio repair shop. Then I got a job with WPAQ, later WBOB and now am an engineer for WHPE."—VAN W. WORKMAN, High Point, N. Carolina.

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tem develops up to 24 inches of mercury, a home tank-type vacuum cleaner about four.

Dipstick Is Quicker Than Eye

WONDER if you ever heard of this auto-repair crook? The station attendant who puts

the dipstick in about half the way, thus showing that the engine needs a quart of oil when actually it is full.

WILLIAM PHILLIPS, St. Ignace, Mich.

We Can't Dodge This One

YOU state [Nov.] that Dodge offers only one engine for 1957 . . . We have four separate V-8 engines. It's true that they have the same displacement. But horsepower ranges from 245 in the Red Ram to 310 in the Super D-500.

On the same page you also state that the height of the car has been reduced three inches. In fact, the car has been reduced 4½ inches . . . Your illustration also indicates that the height reduction was accomplished by reducing road clearance. Actually, minimum road clearance is the same on both our 1956 and 1957 models.

FRANK W. WYLIE, Public Relations Manager, Dodge Division, Chrysler Corp.

Current Topic

CAN you help me solve an argument that started between myself and a friend and has now gotten around to about half the town's population?

Will a refrigerator use more electricity (after its contents become cold) when it is completely full or when it is partly empty?

KARL A. HERZOO, Hawesville, Ky.

The current used after the refrigerator and contents are cooled to the set temperature depends on the heat loss through the insulation and on the outside temperature. So it won't make any difference whether the refrigerator is full or empty.

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Views up to 40 MILES AWAY!

$12.95 VALUE

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NOW SLASHED TO

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10 inches overall

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No. 76.....99c

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Deluxe Leather SHEATH

FREE!

50,000 SOLD AT $3.95

NOW ONLY $1.98

9" *long when fully open*

10 TOOLS IN ONE

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No. 18.....now $1.98

IMPORTED SWISS ARMY TYPE KNIFE

FAMOUS MONTE CARLO STEAK KNIVES

***Nationally Advertised* at $2.00 each**

NOW ONLY 33c each

Our greatest cutlery bargain ever! Same Monte Carlo steak knives advertised in *House Beautiful* at $2.00 each—now yours for only 33¢ (in lots of 3). All brand-new, first quality! Bargain possible because we import direct from Continent by the boatload, sell direct by mail, eliminate needless distribution costs, high middlemen's profits! Stainless steel knives, hollow ground, like a barber's razor. Serrated edges. Never need sharpening or polishing. Handles in beautiful design of autumn leaves in color of Gold, embossed on pastel Ivory styrene. Breathtaking! Ideal for every setting. Over **ONE MILLION** sold! 10-Year Replacement Guarantee **IN WRITING!**

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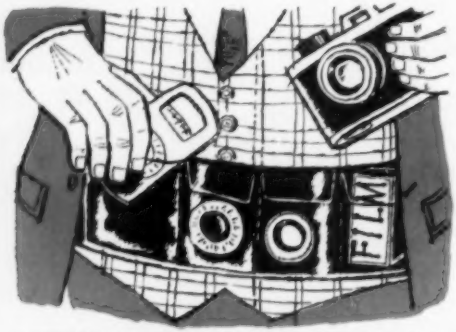
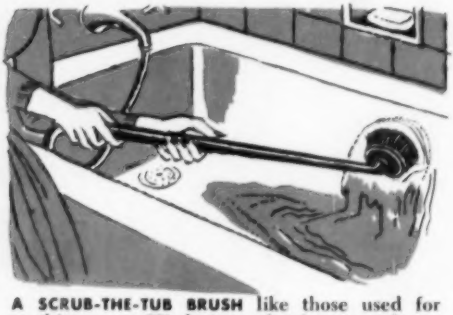
RAINWEAR-VENDING MACHINES. They'd dispense ponchos, hat protectors and cheap three-rib umbrellas made of waterproof, wet-strength paper.—*Charles Scott, Jersey City, N. J.*

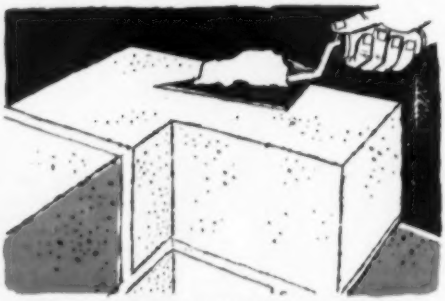


A PHOTOGRAPHER'S ACCESSORIES BELT to eliminate fishing around in a gadget bag. Compartments would hold lenses, filters, exposure meter and film.—*Neil Solomon, Lexington, Ky.*



A SCRUB-THE-TUB BRUSH like those used for washing cars. Hitch it to the faucet and you could scour the porcelain without squatting or back-bending.—*Ethel Ross, Elmhurst, N. Y.*

A CAR RADIO WITH HEADPHONE PLUG-IN. It would sure tranquilize long trips when Junior tunes in rock-'n-roll or bang-bang Westerns by the hour.—*Jack Houser, Fort Worth, Tex.*



L-SHAPED CEMENT BLOCKS. With enough of these on hand, truing corners would be simpler for amateur masons who tackle construction jobs. —*Rube Chernikoff, Washington, D. C.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE MONTHLY readers. What is *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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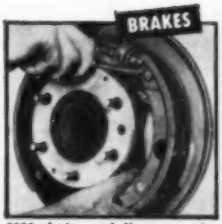
Prize Projects BY PS READERS

Homemade Spot Welder. By rewinding an old transformer, J. F. McCleary of San Diego built up a spot welder that his young son uses safely. Ninety turns of No. 10 wire form the primary winding, and the secondary is a single U-shaped turn of sheet copper 1½" wide. The welder draws 10 to 15 amps and has an output of one volt at about 1,500 amps.

Artist Works in Wood. A window valance makes a single unit of twin end-of-the-room built-in bookcases. The ambitious first project of Calvin Picone, East Hartford (Conn.) artist, the redwood cabinets have glass doors faced with a coping-sawed fretwork of Italian poplar. A saw and drill were the only power tools that Picone used on the project.

Plane Is Grounded. This toy won't fly, but it taxis beautifully and climbs steep grades. Built by Gerard Fortin of Plainfield, Conn., it has a two-hp. air-cooled motor to do the work through a center shaft that runs a drive belt to each front wheel. He used a direct shaft drive to whirl the prop, but later removed it for safety. Control sticks operate the vehicle.

Have you recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to POPULAR SCIENCE MONTHLY'S Mechanics and Handicraft Editor, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.



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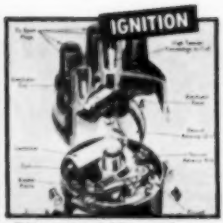
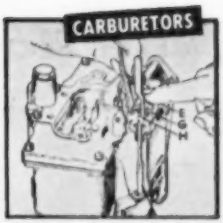
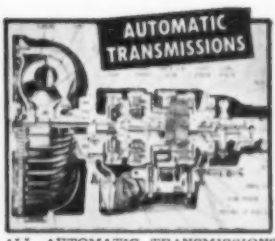


Diagrams, tables and text take the "mystery" out of all ignition systems.



You get illustrated adjustment procedures for all types of carburetors.



ALL AUTOMATIC TRANSMISSIONS are fully covered in special big section. (NOTE: All pictures shown here are greatly reduced in size. Actually, this giant book is almost a *foot high!*)

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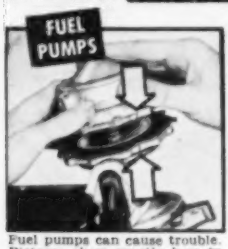
FIX ANY PART OF ANY CAR *in a jiffy!*



Fuel pumps can cause trouble. Pictures show exactly how to take them apart, fix them.

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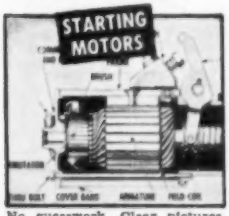

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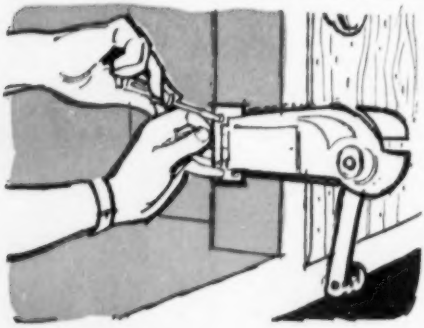
PASTE WAX IS EASIER TO USE if you drop it into a sock and make a tight knot just above it. Rub the encased cake over furniture to wax it; then polish with the leg of the sock.



A WALL CAN OPENER tucks out of sight but is still handy if installed in a cabinet on a one-by-two nailed between two shelves. Mount it so that it clears the door when it's swung out.

TO ANCHOR A BOLSTER over a couch, hang it from brass or plastic towel rings fastened to wall studs. At bedtime, just pull out the couch, leaving the backrest in its wall straps.

ORDINARY WIRE HANGERS will hold skirts and pants neatly if you untwist them, string snap-on clothespins and reassemble. Wrap adhesive tape at both sides to keep a pin from sliding.

THE OLD COFFEE CAN becomes a better paint container when gripped in a vise and flattened along one side. The straight edge makes it easier to wipe excess paint from the brush.

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In addition to training in Auto Mechanics, CTI will send you complete instruction in Diesel Mechanics or Body & Fender Rebuilding—at no extra cost.

PROOF THAT CTI TRAINING GETS *RESULTS*

"Without CTI training, I would not have the job I hold today. When I showed my CTI diploma, I was given a chance to work as a mechanic."—W. O'NEIL, PA.

"Have bettered myself nearly 100%. Am in partnership with another fellow and we have 24 cars of our own."—A. H. CATES, ME.

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"Have had 3 pay raises in 8 months. Before I took the course, I knew very little about an engine."—W. LONG, PA.

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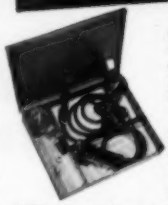

Only CTI sends you this Engine Tune-Up Kit! It helps you locate engine troubles quickly. Included in kit is a Compression Tester, a Vacuum Gauge and Fuel Pump Tester, an Ignition Timing Light, and a portable steel case. These are fine-quality instruments, the kind that experienced mechanics use. Each is the product of a famous manufacturer. You get this Tune-Up Kit at no extra cost—it's included with your CTI training.

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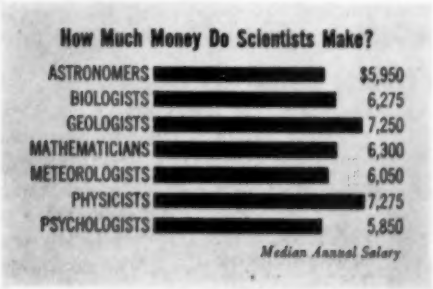
You ought to know...

The rare engineer who can tool up a really good sentence is being hunted aggressively by industry—take a look at the help-wanted ads. All engineers need to write clearly, of course, so that they can get their ideas across to fellow engineers. But the specialized technical writer has a tougher job: preparing reports and manuals for people who are not trained engineers. These men need the scientific knowledge of professional engineers and the writing skill of professional authors. It's hard to find such men.

The problem is the growing complexity of modern equipment. IBM, for example, is building millions of dollars' worth of electronic computers for the SAGE radar system. It must also provide manuals explaining how to operate and maintain them. The manuals, which contain 20,000 pages and stretch across a 12-foot book shelf, occupied 75 tech writers for nine months. Civilian equipment—appliances, radios, trucks—is more complicated now, too, and requires carefully prepared instruction books.



This rare combination of skills—only a few colleges, such as Purdue and Rensselaer Polytechnic Institute offer full scholastic programs in the specialty—commands a good price, naturally. Experienced tech writers are being offered as much as $8,000 to $12,000 a year. Supervising editors get even more.

That's about what other scarce specialists make. The Government's National Science Foundation surveyed 47,000 research scientists (this group is about a fifth of the total in the U.S., and includes no engineers, few scientists-turned-executives). Half of them earn more than $6,525 a year. Some, physicists for instance (see chart), do considerably better.

Some man-made moons may be brought back from space—whole—scientists of the Rand Corporation suggest. Not the moons already built for launching this year. They are made of magnesium, and will get so hot from air friction when they re-enter the earth's atmosphere that they will burn up, like meteors. But some alloys being tested for jet-engine turbines could resist the friction heat, which might be kept down to about 2,000°F.

A recoverable moon would be very useful because it could bring back data that cannot be radioed—for instance, very-high-altitude photographs showing cloud formations over almost half the earth. These would be invaluable to weathermen working

You ought to know...

on long-range forecasting theories. The big problem would be finding such a basketball-size moon after it landed.

Stricter control over the atomic radiation you can get was recommended by a Government-sponsored committee. Its suggestions, which will probably be made obligatory, set an average limit on the exposure that the general population can take safely—10 roentgens per person up to age 30—and sharply reduced the total dose permitted atomic workers.

Meanwhile an expert on atoms and health, Dr. John C. Bugher, warns that we should be more concerned about atomic power plants than about weapons-testing. "Even a modest nuclear-power program," he says, "will bring into existence vastly greater quantities of radioactive materials than . . . the development of nuclear weapons." For the inside story on the most ominous atomic material, strontium 90, see page 163.

Tax relief for the ever-growing station-wagon set may be coming, in the form of lower license fees. Six states now charge extra for plates for wagons, as tabulated at left. But New York, which gains nearly $2,000,000 a year from the bite on wagon owners, is considering eliminating this discrimination and taxing all passenger cars on an equal basis. For a full report on the delights of wagons, see page 104 . . . Driver training in high schools got a big boost in Michigan. Young drivers (under 18) there now have to pass such a formal driving course before they can get licenses.

Station-Wagon License Costs More in Six States

CONNECTICUT	Passenger-car fee plus $2
DELAWARE	Fee based on truck rate
MASSACHUSETTS	Fee based on passenger-car rate, but minimum is $6
NEBRASKA	Fee based on truck rate
NEW YORK	Fee based on higher rate for heavy passenger cars
VIRGINIA	Fee based on weight at higher rate

Source: National Highway Users Conference

Short takes. Feed your dog mashed potatoes and cooked pork? Won't hurt him at all, says Dr. C. M. McCay of New York State College of Agriculture . . . Transistor radios and sun-powered radios may get a bit cheaper—the price of the pure silicon they need has dropped for the second time in six months . . . One of these days you'll be hearing about a revolutionary new triangular-shaped bullet . . . The most powerful radiation source in industry, a 3,000,000-volt Van de Graaff, started smashing atoms at Shell laboratories to help develop tough oils for nuclear engines . . . The trouble with atom sub No. 2, the Sea Wolf, was the molten sodium metal that transferred heat from the atomic furnace to the steam generator. The corrosive stuff caused leaks in one section of tubing. The Navy plans no more sodium-cooled engines, but they still look good for land power plants.

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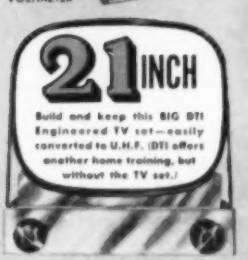

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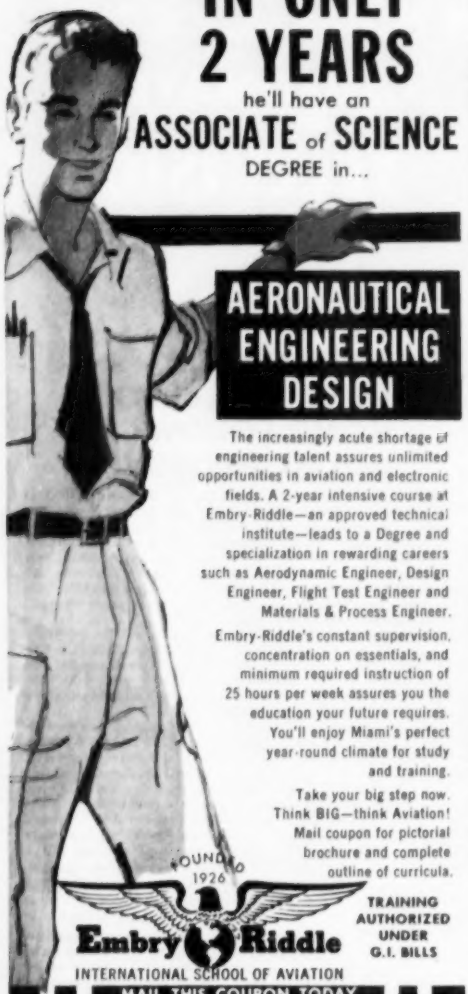

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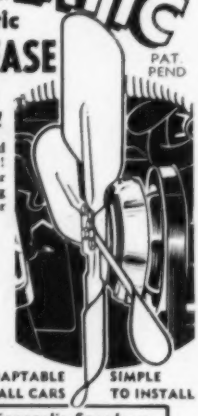

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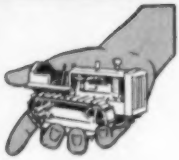

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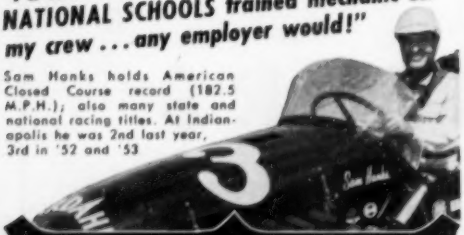

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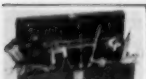

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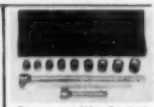

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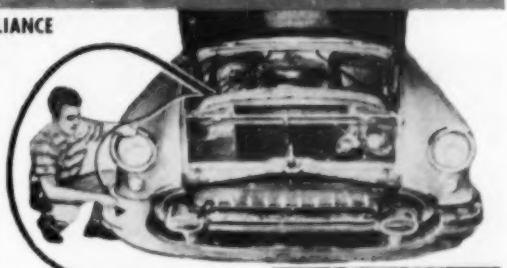

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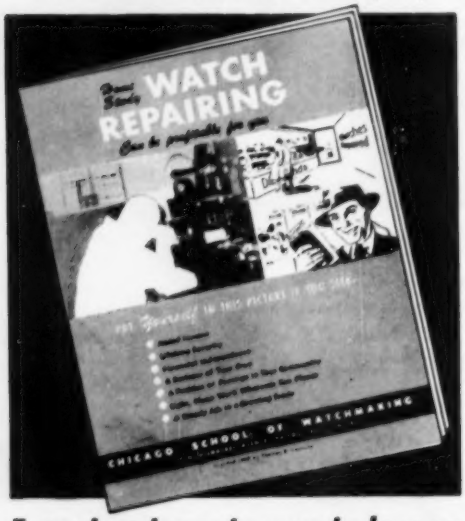

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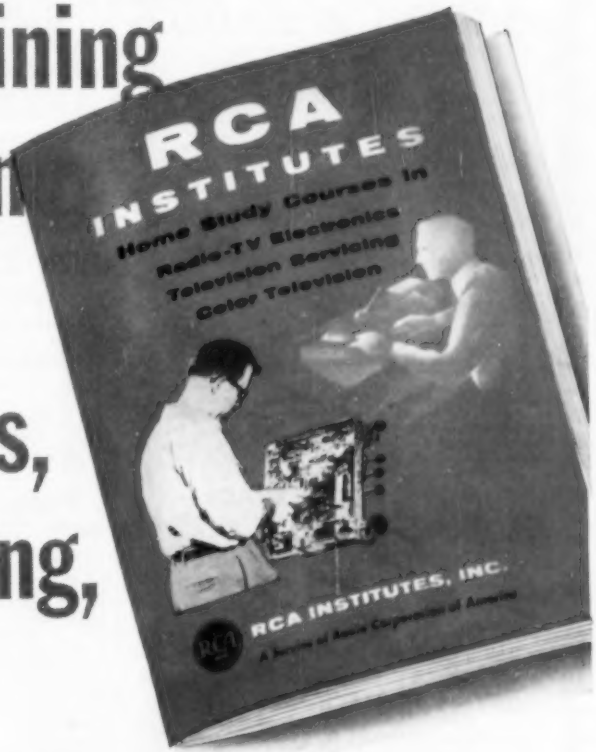

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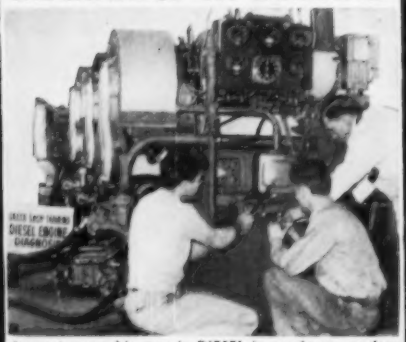

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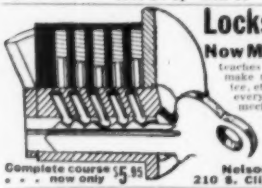

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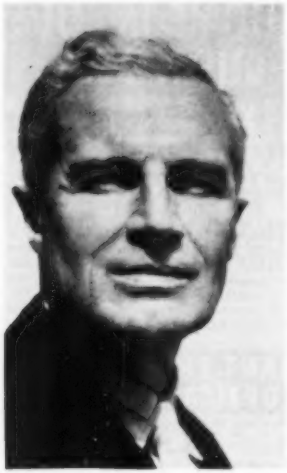

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I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Jack B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things; of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life, is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

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I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows". It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own". It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

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Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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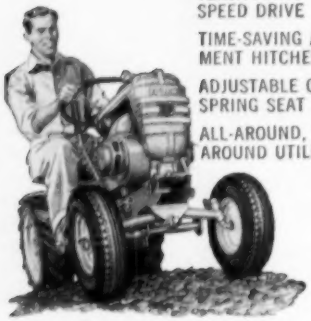

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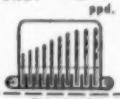

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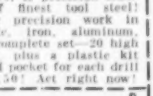

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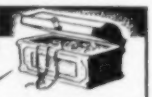

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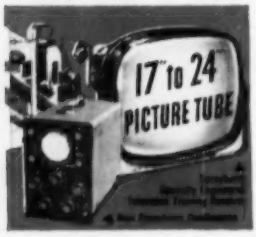

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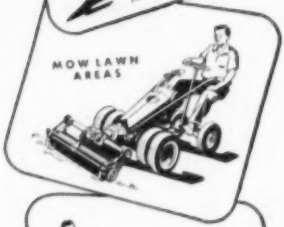

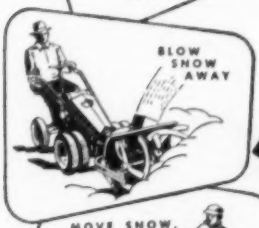

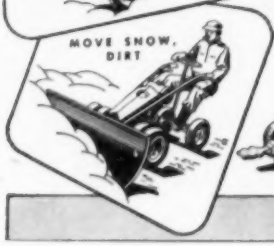

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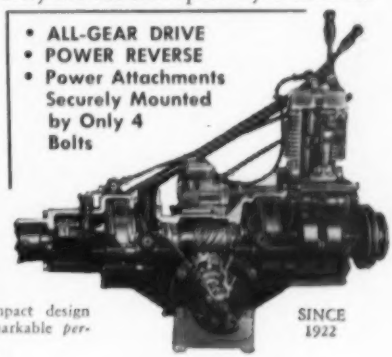

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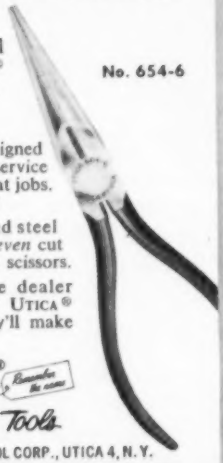

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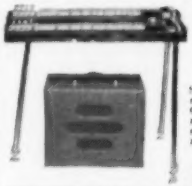

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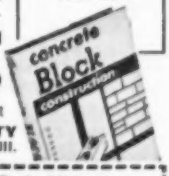

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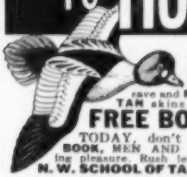

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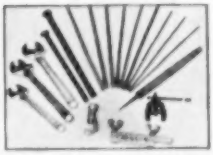

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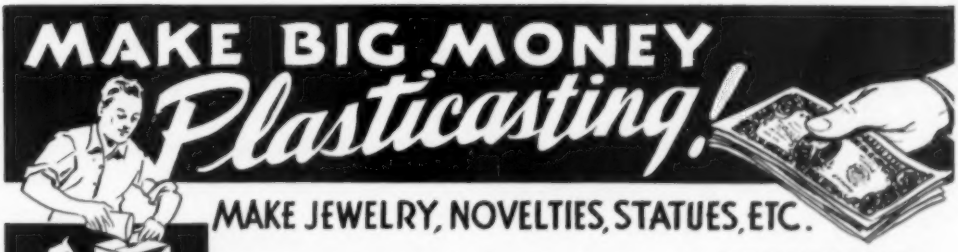

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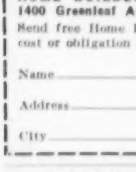

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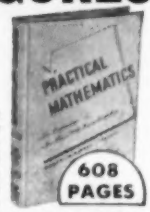

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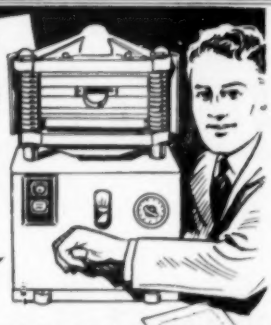

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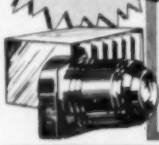

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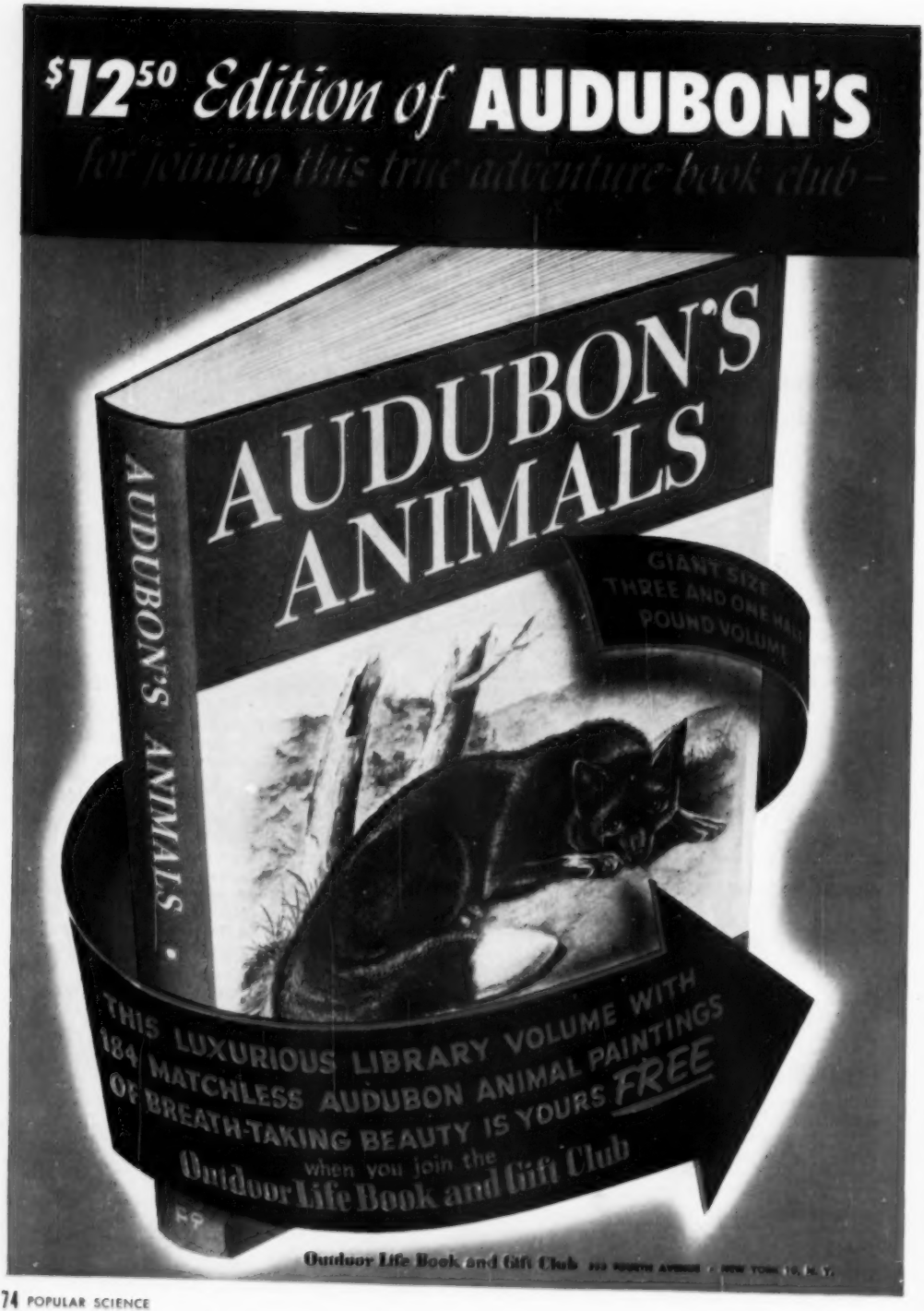
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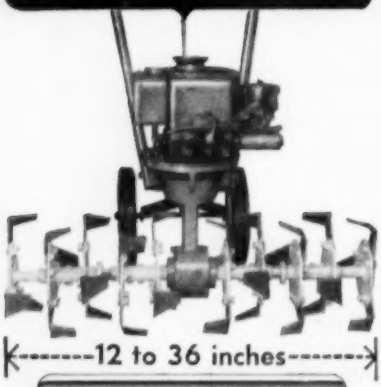

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USE THIS HANDY INDEX TO FIND WHAT YOU WANT

Advertising, Agencies for Advertisers ... 53
Agents Wanted ... 43
Antiques, Relics & Indian Goods ... 20
Artists Supplies ... 76
Authors Service ... 52
Auto Supplies & Equipment ... 2
Auto Trailers ... 3
Automobiles & Midget Cars ... 1
Aviation ... 5

Batteries, Generators, Etc. ... 6
Boats, Outboard Motors ... 11
Body-Building Courses, Jiu Jitsu, Etc. ... 12
Books & Magazines ... 23
Build It Yourself ... 66
Business Opportunities ... 37
Business Service, Information, Name Lists ... 50
Buy It Wholesale ... 38A

Cameras, Photo Supplies ... 34
Camping Equipment & Tents ... 16
Cartooning, Sign Painting, Chalk Talks ... 54
Chemistry & Physics ... 41
Claim Investigators ... 37A
Coins & Currency ... 26
Color Photo Finishing ... 32A
Contests ... 46

Detectives ... 47
Dogs, Birds, Hamsters & Pets ... 17

Earthworms ... 18
Educational & Instruction ... 45
Electrical Supplies & Equipment ... 7
Engines, Motors, Etc. ... 10

Farms, Other Real Estate ... 19
Field Glasses, Telescopes ... 14
For Inventors ... 60
For Sale Miscellaneous ... 71
For the Home ... 69
Formulas, Plans, Etc. ... 39

Games & Entertainment ... 24A
Geiger Counters, Treasure Finders ... 77

Help Wanted ... 42
High-grade Salesmen ... 44
Hobbies, Collections ... 31
Home Craftsman ... 65
Hypnotism ... 24

Inventions Wanted ... 61

Language Outfits ... 48

Machinery, Tool Supplies, Etc. ... 9
Magic Tricks, Puzzles, Etc. ... 25
Manufacturing ... 63
Minerals & Precious Stones ... 30
Miscellaneous ... 79
Models, Model Supplies ... 64
Moneymaking Opportunities ... 38
Motion Pictures, Slides, Sound Equip. ... 33
Motorcycles, Bicycles & Supplies ... 4
Music, Song Writers & Records ... 35

Of Interest To Women ... 70
Old Gold, Jewelry, Watches ... 67
Old Stamps Wanted ... 27

Patent Attorneys ... 59
Patents For Sale ... 62
Personal ... 80
Photo Finishing, Photocopies, Etc. ... 32
Plastics ... 40
Plays, Stories, Etc. ... 49
Poultry & Supplies ... 21
Printing, Multigraphing, Etc. ... 57
Printing Outfits, Supplies ... 58
Profitable Occupations ... 22

Radio, TV, Supplies & Equipment ... 36
Razor Blades, Shavers ... 74
Rubber Stamps & Office Supplies ... 56

Special Services ... 51
Sporting Goods, Guns, Fishing Tackle, Etc. ... 15
Stamp Collecting ... 28
Surveying Instruments ... 79A

Tattooing Supplies ... 75
Tobacco & Pipes ... 68
Trees, Shrubs, Roots & Herbs ... 20
Typewriters & Office Machines ... 55

Wanted to Buy ... 72
Watch Repairing ... 78
Wearing Apparel ... 73
Welding, Soldering ... 8
Wood Preservatives ... 65A

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32 PHOTO FINISHING, PHOTOCOPIES, ETC.

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Bass Fishermen will Say I'm Crazy . . .

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But, after an honest trial, if you're at all like the other men to whom I've told my strange plan, you'll guard it with your last breath.

Don't jump at conclusions. I'm not a manufacturer of any fancy new lure. I have no reels or lines to sell. I'm a professional man and make a good living in my profession. But my all-absorbing hobby is fishing. And, quite by accident, I've discovered how to go to waters that most fishermen say are fished out and come in with a good catch of the biggest bass that you ever saw. The savage old bass that got so big, because they were "wise" to every ordinary way of fishing.

This METHOD is NOT spinning, trolling, casting, fly fishing, trot line fishing, set line fishing, hand line fishing, live bait fishing, jugging, netting, trapping, or seining. No live bait or prepared bait is used. You can carry all of the equipment you need in one hand.

The whole method can be learned in twenty minutes —twenty minutes of fascinating reading. All the extra equipment you need, you can buy locally at a cost of less than a dollar. Yet with it, you can come in after an hour or two of the greatest excitement of your life, with a stringer full. Not one or two miserable 12 or 14 inch over-sized keepers — but five or six real beauties with real poundage behind them. The kind that don't need a word of explanation of the professional skill of the man who caught them. Absolutely legal, too—in every state.

This amazing method was developed by a little group of professional fishermen. Though they were public guides, they rarely divulged their method to their patrons. They used it only when fishing for their own tables. It is possible that no man on your waters has ever **seen it**, ever **heard of it**, or ever **used it**. And when you have given it the first trial, you will be as closed-mouthed as a man who has suddenly discovered a gold mine. Because with this method you can fish within a hundred feet of the best fishermen in the county and pull in ferocious big ones while they come home empty handed. No special skill is required. The method is just as deadly in the hands of a novice as in the hands of an old timer. My method will be disclosed only to those men in each area who will give me their word of honor not to give the method to anyone else.

Send me your name. Let me tell you how you can try out this deadly method of bringing in big bass from your local waters. Let me tell you why I let you try out my unusual method for the whole fishing season without risking a penny of your money. Send your name for details of my money-back trial offer. There is no charge for this information, now or at any other time. Just your name is all I need. But I guarantee that the information I send you will make you a complete skeptic—until you decide to try my method! And then, your own catches will fill you with disbelief. Send your name, today. This will be fun.

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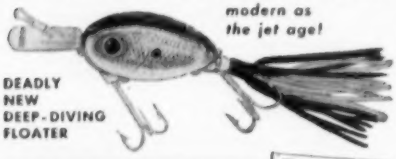

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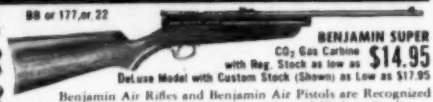

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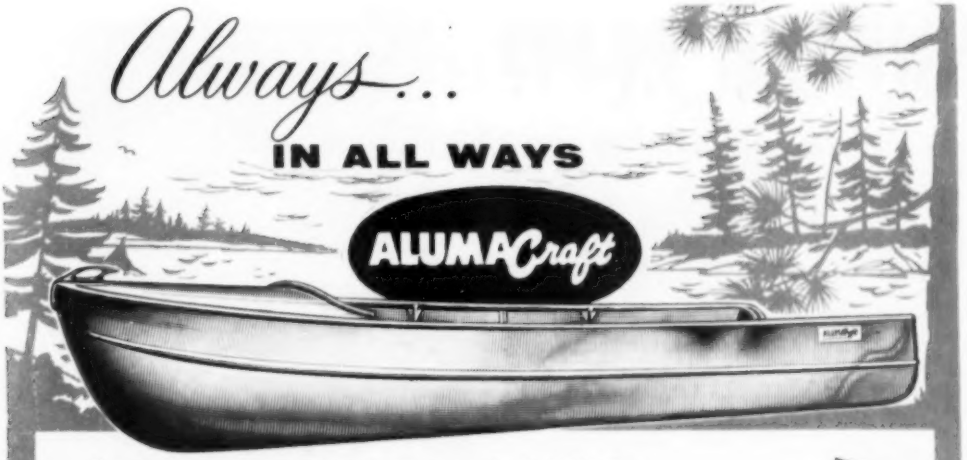

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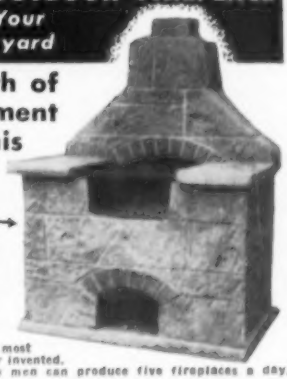

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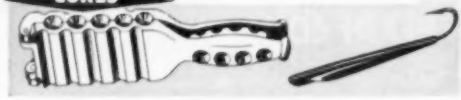

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REG. U. S. PAT. OFF. Monthly

Report from West Germany:

Our Push-Button A-Bomb Is Ready

Perched in mountain hideouts near the Iron Curtain, pilotless bombers by the hundreds are poised for their defense mission.

By Frank Harvey, with photographs by W. W. Morris

THE place is a wild and lonely forest in the Eifel Mountains of West Germany, about 200 miles from the Russian zone. The time is early morning and the fog is so thick that the trucks move in dead slow over the virgin forest floor, their lights blazing in the murk. A few miles away, at the Bitburg air base, dozens of American supersonic F-100 fighters sit grounded by the fog,

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"Devil Birds," wrapped in heavy canvas, roll slowly through German fog on their way to secret

FUSELAGE, containing jet power plant, swings from its transport vehicle to a mobile launcher at the firing site. Note high tail, which moves to make the missile climb or dive in flight.

SHARP-SWEPT WING joins company with the body. The wing is controlled in flight by steel fingers that rise and fall on the top surface in response to radio signals from the ground.

launching sites where they will be assembled.

DUMMY WARHEAD rolls up missile-launcher ramp to be bolted in place in seconds. In war, the Matador's nose section could hold enough atomic power to flatten a great city at one blow.

helpless and useless beside their 10,000-foot runway. Should a Soviet attack come now, the jet fighters would never get off the ground.

A sinister shape that comes toward us under the dark trees is another matter. Lashed to the flat-bed of a giant truck, the wing and fuselage of an M-61 Matador guided missile loom up: a buzz-bomb, American-style, that takes to a foggy morning like a duck to water.

POPULAR SCIENCE photographer Bill Morris and I had come to Germany to see the Matador setup, talk with the officers and men who will launch this deadly bird if the Russians ever strike at us in force, and bring back as complete a report as security would allow.

Now we stood in the mountain fog and watched the 10-man launch team put the Matador together like a giant toy. A crane lifted the bird off the delivery truck onto the launcher, which had been pulled into position by a powerful truck-tractor. The one-piece metal wing was swung into place.

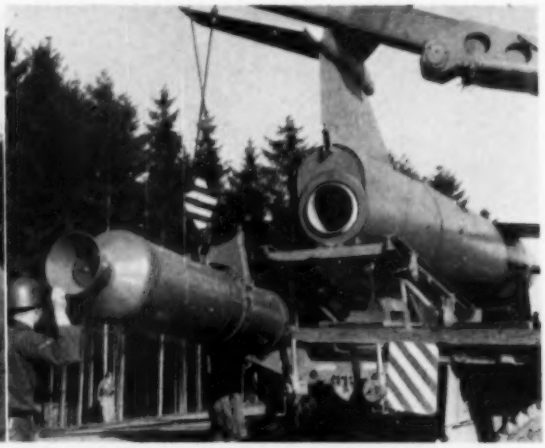
The warhead, carried up by an armament truck lurching through the trees, was hauled up a ramp and fastened in place like the nose of a huge bullet. A small mobile crane swung the big Rocket Assist Takeoff (RATO) jug into position under the tailpipe of the Matador's J-33 jet engine. Men scurried about—plugging in auxiliary power, checking the all-important guidance system and manning the launch panel for the actual run-up of the jet.

With any imagination, this M-61 missile made you shudder a little. It looked like a tiny jet fighter, painted GI tan, with knife-blade wings, a very high tail, and no cockpit. Hidden in the missile's belly was the same engine that powers the Lockheed jet trainer, the T-33. It would drive the flying bomb to 35,000 feet and hold it there at close to the speed of sound while ground radar controllers guided it hundreds of miles into enemy territory and finally "spilled it" on the target. The nose of this missile happened to be empty, because this was merely a practice "count-down"—but it

PREFIRING CHECKS and adjustments are made by highly trained airmen who are on constant alert for the "real thing." The control panel above is for leveling the missile's launcher.

BUILT-IN JACKS, with broad bases for soft ground, level the rig for accurate launching. The position of the launcher on the map must be worked out with pinpoint accuracy.

ELECTRONIC CIRCUITS of the Matador's "brain" must be checked to see that they are in perfect order before firing. Here a crewman gives the familiar "okay" sign after a test tune-up.



ROCKET-ASSIST BOTTLE goes into place. Roaring with 52,000 pounds of thrust, it propels the missile to full speed in only 2½ seconds. It drops off as the jet engine takes over.

could be replaced with an atomic warhead in about 40 minutes. Naturally, the power of that warhead is classified, but it is undoubtedly as great as the power of the bomb that cremated Hiroshima.

Another thing we are pretty sure of—once airborne, the Matador would be very hard to stop. If the Russians had their fastest jet fighters stacked at high altitude, knew exactly when and where the M-61 would be launched, and had perfect teamwork between ground control and interceptor, they might shoot down the missile. Obviously this set of conditions would not be met very often, if at all. In the event of war, the Matadors would be coming thick and fast from widely different angles.

Camouflaging by radar chaff, decoy missiles and electronic jamming would confuse the enemy. Unless our M-61s were wiped out on the ground, our guidance stations were captured or destroyed, or our radar control was jammed, most of the M-61s would get over the bomb line.

READY TO FIRE! Missile is assembled, fueled, armed and elevated for the launch. Although crews only go through dry runs in Germany, hundreds of Matadors have been test-fired.

The payoff question is, of course: would they hit?

Lt. Col. Louis Wright, CO of the 585th Missile Group, stood beside Morris and me to answer such questions as he could, within the limits of security. I tossed him a curve. "I've heard these Matadors won't hit within 15 miles of where they are aimed," I said. "How about it?"

Wright smiled. He's an old pro, familiar with the tactics of interviewers.

[Continued on page 248]

CAMOUFLAGE NET, blending with adjoining wooded area, neatly hides shape of a Matador guided missile as it sits, ready, on its launcher. This alert status is maintained at many sites.

The Big Boom in Detroit:

14 New Station Wagons

An Open Letter to the Man Who's Hankering for a Station Wagon

You have a lot of company. Since 1940, wagon sales have gone up *2,500 percent.* This spectacular increase has paralleled the flight to the suburbs and the trend to bigger families; in the same period the birth rate has risen 30 percent. Where the perambulator rolleth and the power mower hummeth, the station wagon cometh.

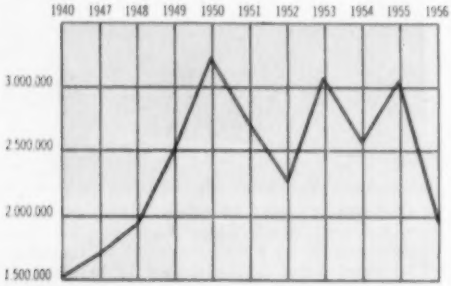
The question is: Why? Compared with the conventional sedan or hardtop or coupe, the wagon is draftier, rattlier, heavier. It's harder to steer, harder on tires. More skittish in a crosswind. Not easy to park until you get used to it. And it costs more.

Ah, but there's another side to it! One little word speaks volumes: SPACE. Try toting firewood in a hardtop or a passel of kids in a sedan. Try tugging a new drill press home in a convertible. Try hauling in a coupe the five bags and a hatbox your wife wants on vacation. Wagons welcome moppets and mops, bikes and bassinets, dogs and dogwoods.

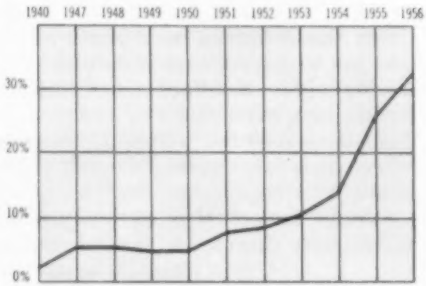
Nor is that the whole story. As a sop to man's vanity, the wagon is unsurpassed. Parked at the country club or the supermarket, it lends social stature to the owner. Like a mink stole, it is a symbol of opulence. And for this year of 1957, station wagons fairly reek of luxury. Take a look at the next eight pages—at your own risk.

Devon Francis

Factory sales of four-door sedans have fluctuated, as the graph shows, while . . .

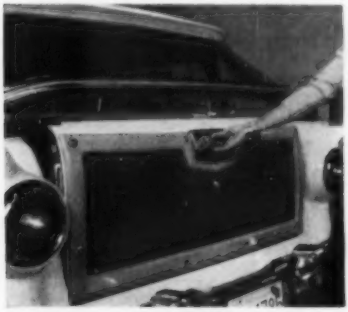


. . . the percentage of station-wagon sales to sedan sales has skyrocketed.

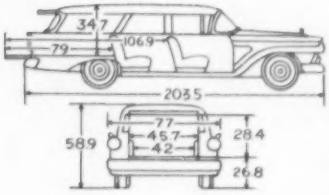


Ford

FORD wagons, biggest sellers, continue to have some of the most capacious interiors. With the second and third seats removed and a mattress installed, the cargo compartment makes a bed for two. A wraparound rear window lends elegance to the styling, and new hardware



gives positive locking with minimum effort. The transom is spring-loaded—and to the man who knows wagons, that's a revolutionary improvement.

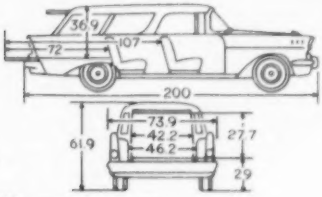


Chevrolet

PERHAPS the highest-styled item among big-selling wagons, the Chevrolet tends to sacrifice some room to beauty. That delights the country-club set. Featured here are canted centerposts and easy-slide ventila-

tion windows. Chevrolet was the originator of the curved transom in wagons. The styl-

ing extends clear back to the chromed speed strips on a curved tailgate which, like Pontiac's, is supported by cables.

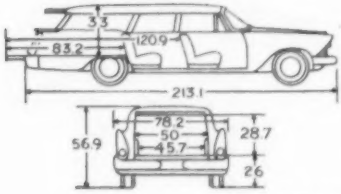


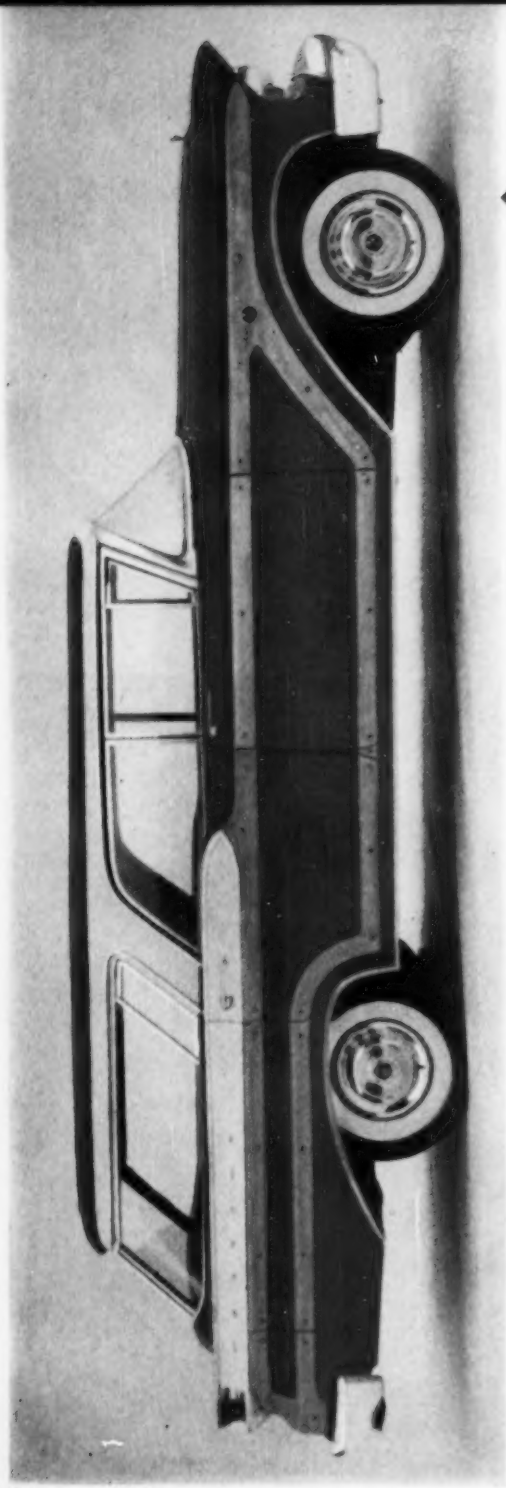
Plymouth

LIKE DeSoto and Dodge, Plymouth has a rearward-facing third seat that need not be removed to convert the wagon for cargo. Simply flip over the seat part, then drop the back forward. Each folds flush with

the floor. To mount to the third seat, rubber step-pads are provided on each of the

bumper's sides. Rubber strips on the door protect it when it rests on the bumper. Its glass rolls down electrically.

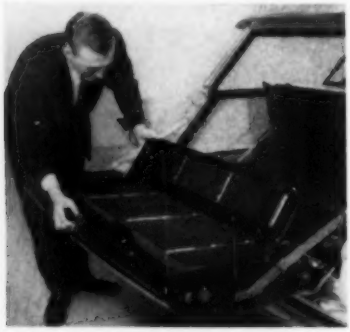




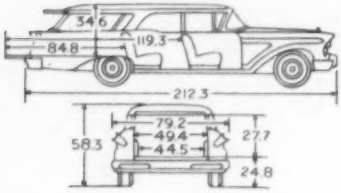
Mercury

AN ULTIMATE in luxurious convenience is built into Mercury's new versions of the station wagon. The rear window comes down electrically with the turn of a key in the tailgate lock. Another control for that

window is beside the driver. And that's not all—the gate itself is counterbalanced; the



valley between gate and cargo floor is bridged. A safety feature: a positive lock for the removable second seat.

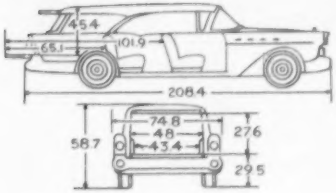


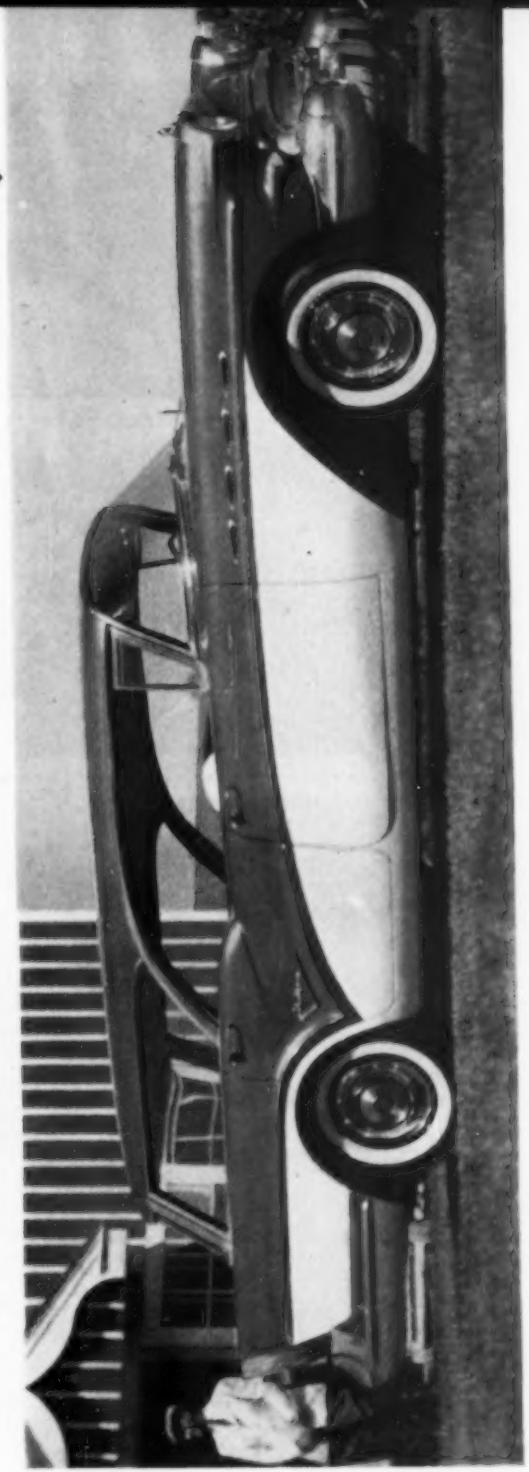
Buick

CHROME strips that run three-quarters of the length of the roof give the Caballero (Buick's Spanish for station wagon) that ready-for-takeoff look. An optional novelty inside the wagon is a second seat,

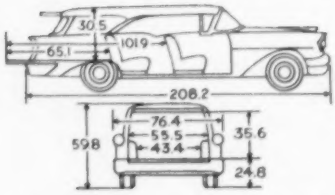
split to help carry long objects like fishing poles and lumber. The manufacturers finally are getting around to easing the

job of opening and closing the cargo doors. Buick's hardware is simple to operate.



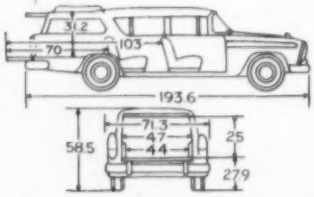


Oldsmobile



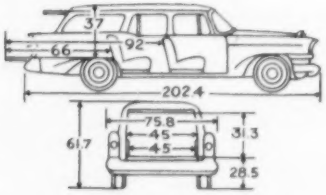
Olds' first wagons in six years are large, swank "hardtops."

Rambler



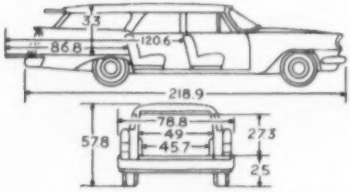
The Rambler's cargo bed has been lengthened an extra eight inches.

Studebaker



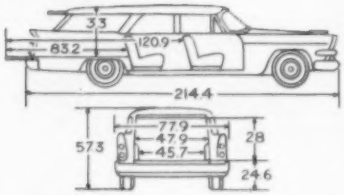
The Studebaker has special rear springing to support heavy loads.

Chrysler



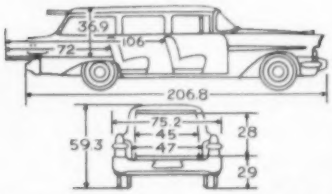
With tailgate open, the Chrysler's cargo floor extends to 10 feet.

Dodge



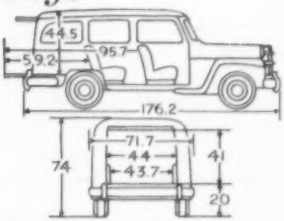
Dodge's fuel tank is tucked snugly under the flaring left rear fender.

Pontiac



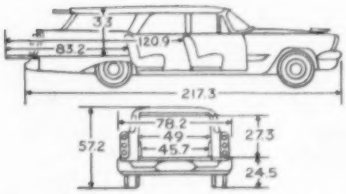
Pontiac's four-door Safari wagon has hand-buffed leather inside.

Willys



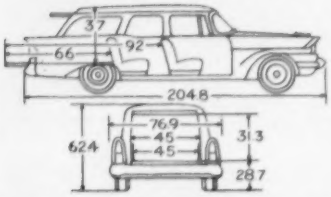
The high-roofed Willys can tote a big handyman cargo: 100 cubic feet.

DeSoto



DeSoto's wagons now offer air conditioning as a cool option.

Packard Clipper



A wagon, significantly, is Packard Clipper's first offering for '57.

At long last, the wagon is getting its just due

Three can ride in Dodge's reversed seat

Spare tire is tucked inside right rear fender.

LAST winter the Chrysler Corp. displayed a "dream" station wagon called the Plainsman, as gadgety as all get-out. Today it's in production. With a rearward-facing third seat (see the magazine cover) that folds flush with the floor, and gas tank and spare tire mounted in left and right rear fenders, respectively, this design wins the honors for novelty hands down. The features of the Dodge, pictured at left, are available also in the DeSoto and Plymouth.

Styled for glamor, these wagons nonetheless are as practical as a back-scratcher. Wrestling that third seat out of the car to make room for cargo has elicited naughty words from many a wagon owner, and the people who have bumped their heads creeping back to the third seat are legion.

As for 1957 wagons in general, almost all the cargo beds—including even that of the extra-compact Rambler—are longer. Five are wider. But lower roof lines reduce the *depth* of the loading gate. Buick's and Ford's are shallower by four inches, Mercury's by 5½.

Yet, all in all, wagons at long last are getting their just due on the design table. The pesky transom is being spring-loaded, or eliminated by means of roll-down windows, and torsion bars lighten some of the new gates. A reclining right front seat, like Pontiac's, bids fair to become popular. END

The Cars We Bought: 10 Years of Startling Changes

IN THE decade just past, U. S. cars have undergone sweeping changes in styling and mechanism; never in its history has the auto industry moved so fast. The start was slow. Car-famished postwar customers readily recognized old friends of '42 camouflaged in '46 chrome. Some designs were largely words—remember the Tucker and the Playboy? The true shape of cars to come was forecast when Studebaker unveiled its startling "which-way" model. Change in cars quickly gained momentum, shooting away from the past with a speed symbolic of the power race that was to follow. As in the Mercury below, the matronly bulges of '46 have given way to a lean, long '57. The next six pages picture other reminders of this 10-year transformation.

Before: fat and '46

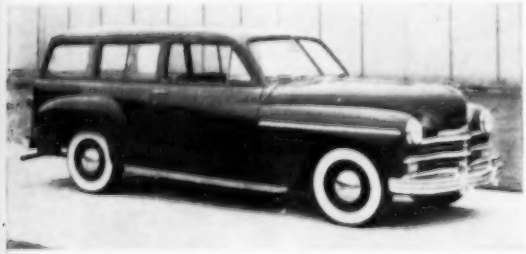
After: a sleek and sassy '57

10 EXCITING YEARS:

Survival of the longest

Roomier

'49 crossbreeds: the sedan-wagon . . .

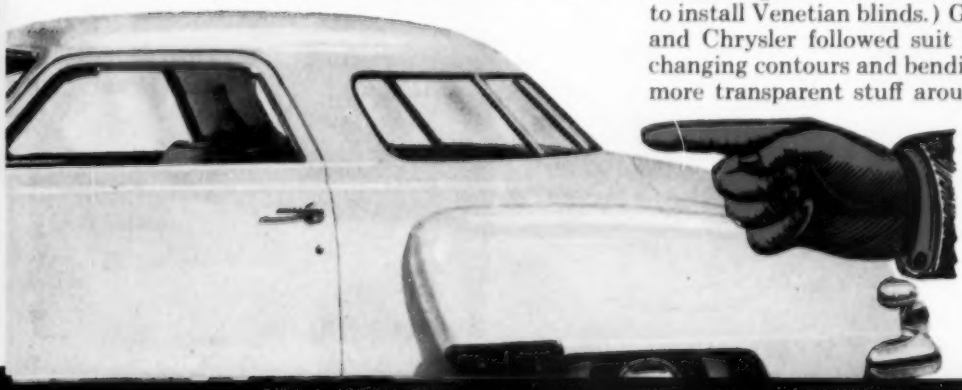


. . . and the convertible that didn't convert.

Classier

Wrapped at both ends

THE decade brought several boons to drivers. For straining eyes, Studebaker wrapped the rear in glass. (The unaccustomed glare led some owners to install Venetian blinds.) GM and Chrysler followed suit by changing contours and bending more transparent stuff around



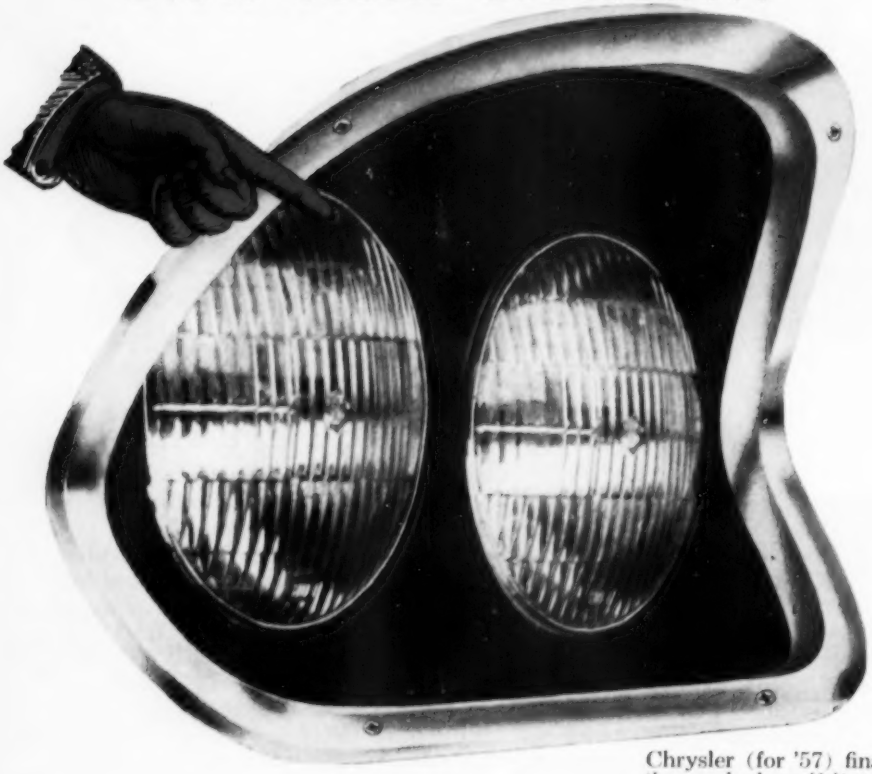
This '56 Lincoln has the shape you love to buy. Stretched 7¼ inches and lowered 2½, it outsold its predecessor two to one.

THE fashion story is one of hemlines moving in one direction—down. In a decade, road clearance dropped on some cars to a scant six inches. Rooftops have sunk about nine, till floor-to-ceiling height is around four feet, making men's caps more than a fad. As engines grew shorter, cars grew longer, by an average of half a foot. Much of the length hangs out behind, with five-foot bustles sometimes overflowing through garage doorways. Two new body styles came in and sold like cut-rate currency. The all-steel sedan-station wagon, hinted at when Willys dropped a boxy body on a Jeep, became a reality with the Plymouth Suburban. Since then the demand for wagons has snowballed—but today's plush models are a far cry from the utility vehicle that started it all. The hardtop—Kaiser and DeSoto both claim feeble firsts—got its main boost from Buick (left) and from the general move to sportier, speedier lines.

the front, reintroducing occupants to their long-lost right-front fenders. Stronger sealed-beam lights and a four-eyed system came next. For sitters' comfort, there were new suspensions, foam-rubber cushions, fatter tires on wheels that shrank from 16 to 14 inches.

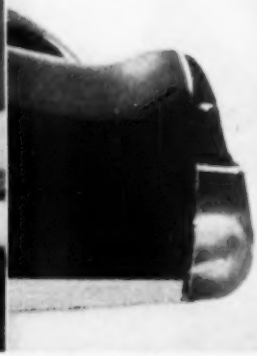
10 EXCITING YEARS:

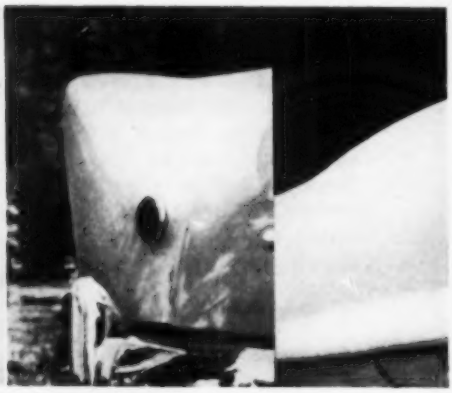
Now beetle-browed...



Chrysler (for '57) finally made the car look as if its eyes could really blink and close shut.

...and finny-tailed





Airplane fin, aped by groundlings (Cadillac first), went up and up, leaving but one way

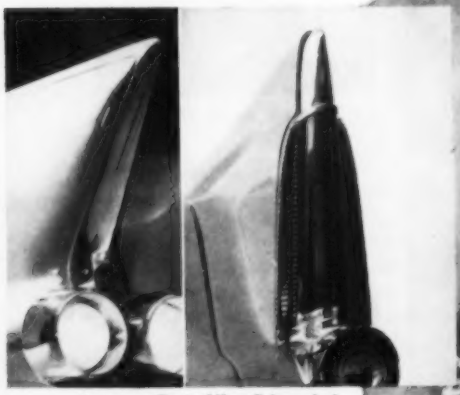
Eyebrows started at top with Cadillac. . .

. . . worked down price scale to Chevy . . .

IN 1948, a few months after GM's chief stylist had taken a flier in fins, the front office planned a quick change to drop them—until sales reports came in. Ever since, cars have gone in two opposite directions at once: toward flash and toward ostentatious simplicity. This has been the era of Detroit's version of the sports car, of aviation names like *Thunderbird*, *Rocket* and *Flight Sweep*, and of gaudy two- and three-tone color. (It was said that Ford and Chevy could complete a year's production without repeating a single car if color combos, body styles and mechanical options were mixed.) Toward the end of the decade, the eye won out, and pastel pastiches were passing from popularity.

Although special door locks, dished-in steering wheels, and seat belts made good sense, the safety gambit never really attracted crowds.

. . . kept growing bigger, more menacing.



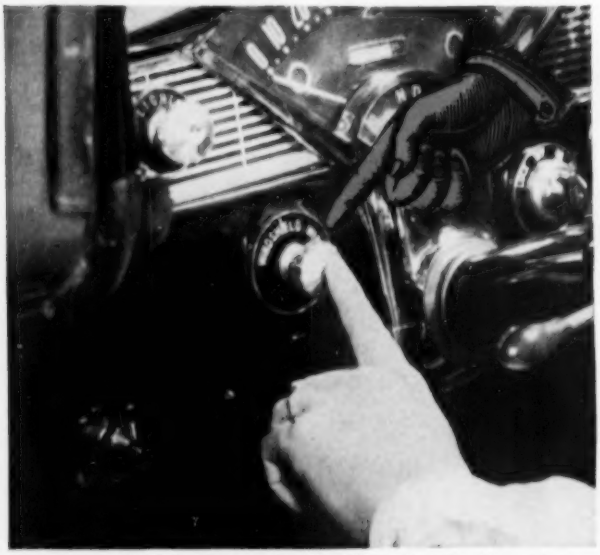
to go: Out, like Lincoln's.

The word is

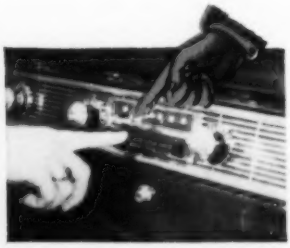
Each year's model has to outzip the last: Here a '56

OOMPH that's more than skin deep takes a while to develop. As late as 1951 Ford had only 100 hp. Cadillac was loafing along with 160 when it suddenly found itself staring at the wrong end of 180 Chrysler horses. The race was on, and soon Chevy, Ford and Plymouth were well over 200 hp., with the big babies over 300. Speed? Stock cars have broken 140 m.p.h. and nobody worries about insurance costs. Scat? 0-60 under 10 seconds, easy. The secret is the compact, over-square, high-compression OHV V-8.

The new game of button, button

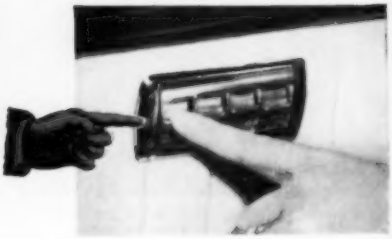


Problem: Which does what? Well, here's the wiper.



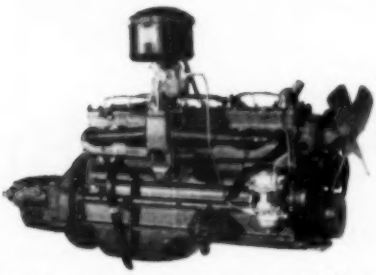
This must work the radio.

Do these move windows?

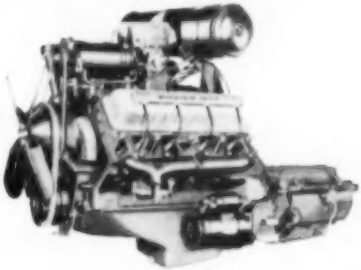


"ssssssssssscat!"

Lincoln takes a '55 in a proving-ground drag race. It's unthinkable for the newer to be slower.



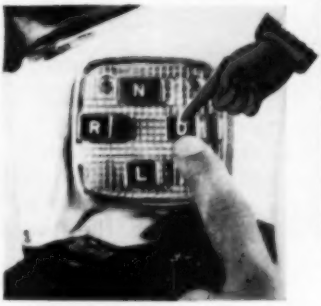
The late straight-8 (this is an Olds) was simple but bulky, heavy, thirsty for gas.



New V-8 (Olds' Rocket, above, was first) has more power per pound, per gallon.

Is this set for the seat?

Transmission, of course.



But something's left over!

SHE only walks from her car to the door but she's got athlete's foot, a drug ad used to say. No wonder, when the poor girl had to work both hands and feet to run the primitive vehicle of her time. Auto automation had a tiny beginning with a few Hydra-Matics before World War II, but by '50 Chevy had Powerglide and Ford soon was going 'matic, too. In '51, Chrysler introduced power steering. It seemed only logical, too, to do something about leg braking. And who had the strength left to crank up a window or push down an aerial? All of this called for dozens of extra horsepower for the gadgets alone, to say nothing of a 12-volt system. Joining the anti-exercise campaign, house builders went to automatic garage doors.—*David Lindsay.*

The Cars We'll Buy

By Harland Manchester

NOT since the triumph of gasoline over steam has there been such a spate of yeasty conjecture about the cars we'll be driving in another decade. Many Detroit prophets are taking the view that drastic or even revolutionary changes are in order. For 30 years, they point out, engineers have squeezed increasing power out of the Otto-cycle engine. Compression ratios and octane appetites have steadily risen. The fabulous engine of 10:1 compression that Kettering and Boyd tested in 1940 is now on the road, and 12:1 jobs are just around the corner.

But from now on, each added compression increase yields smaller dividends, creates new engineering problems, and harasses refiners producing the super-fuels that fastidious engines demand. A new and less choosy power plant is in the cards, the prophets say, pointing to the gas turbine, the free-piston engine, or perhaps to the diesel.

Other company prophets, overlooking the substantial sums spent by the Big Three on radical new engines, dismiss them as fantasies. Many engineers whose decisions count make an excellent case for the future of today's engine. The gas-turbine boys are shooting at a moving target, they say, and it is much too early to order flowers for the Otto.

In the 10-year crystal ball of Victor G. Raviolo, director of Ford's Advanced Product Study and Engineering Research, there is no gas turbine as a power source for the passenger car. He sees an increasing trend to packing more power in today's engine.

"I am certain," he said, "that we can expect at least

A decade from now, the three 1957 vehicles shown at left may seem the primitive beginnings of a three-way functional split, say Detroit prophets. There'll be the inexpensive suburban runabout, the fast personal car, the luxurious family cruiser. Drastic new power plants are a possibility, greater safety and comfort a certainty.

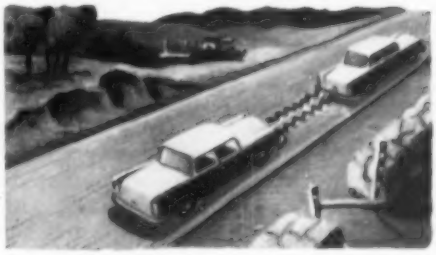
in the Next 10 Years

25 percent and possibly as much as 40 percent more horsepower in the next few years."

"What will the motorist get out of it?" I asked him. "More speed?"

"No," he said. "Present roads do not justify more speed. An important benefit will be better passing ability in the mid-speed range of 50 to 60 m.p.h. More power is also needed for accessories, which may use 40 to 45 hp."

Fuel injection may take the place of carburetors, he says, but on present engines will offer no significant gain in fuel economy and will not lower the engine's octane appetite. If applied to a newly designed engine, however, with a different combustion chamber and a larger manifold, it would be possible to get 25 percent more power out of the same size of engine, with a potential fuel economy of 10 to 15 percent.



Rear-end collisions may be curbed by electronic devices that detect and warn of a dangerously high closing rate on any obstacle just ahead

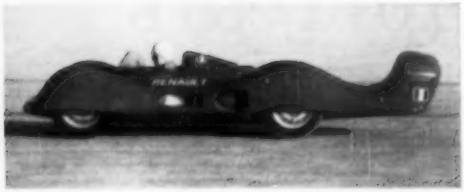
Raviolo predicts even lower cars, dropping within 10 years to 52 inches from today's range of 54 to 61 inches. Ground clearance would be about seven inches. That will raise two major problems—entrance and visibility. Auxiliary roof doors may be needed to enter these beetles, like the butterfly doors on the Mercedes 300 SL. Visibility may be somewhat impaired, he predicts, because of the lowered height of the eye above the ground.

Automatic air conditioning will be a feature of the car of 1967, with summer ventilation *through* the seats. Windows will normally be sealed and will fit flush with the outer skin to reduce wind drag and noise. There will be a hatch for emergency exit. A new steering system will

have an automatic servo-mechanism to compensate for road irregularities and side forces.

On safety, Raviolo points to the increase in rear-end collisions on high-speed highways and concludes that errors in distance perception are a leading cause.

A warning device to show the driver his rate of approach to the car ahead will be adopted, he predicts. Ford is not working on a warning device, but several possibilities occur to Raviolo. Radar might be used, but this would also reflect roadside objects on curves. Could it be taught to reflect cars selectively? Short-wave radio devices mounted in all cars might do the job, or there might be a system of communication from wires imbedded in the highway itself. A preliminary step might be a special short-wave band for car radios, always open to signals from police transmitters spotted along major roads.



The gas-turbine speed record (191 m.p.h.) is presently held by this experimental Renault racing car. It weighs only 2,094 pounds and has 270 hp. at 28,000 r.p.m. It has no transmission but does need a reduction gear. With fuel economy no object, it has no heat exchanger

Raviolo's blueprint for the car of the future is based on a conviction of continued prosperity. He states that in 1960 the number of families owning cars will increase from today's 66 percent to 72 percent, and that two-car families will increase from eight percent to 12.5.

A suburban utility runabout so short that two of them will go between two parking meters is what Raviolo sees for this market. Such a car, he says, will carry two adults, two children, and the equivalent of a four-by-eight plywood panel in the cargo space. It will have a light, economical engine, and will be priced to compete with many used cars.

Coil and leaf springs will become obsolete, says Raviolo, and cars will be sprung on air. He commends the new Citroën as an excellent example of air suspension, though too expensive now for mass-sale cars.

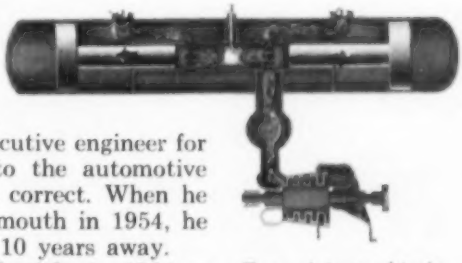
Harry Chesebrough, Chrysler's executive engineer in charge of production planning, takes a dimmer view of air springs. He says they are all right for buses but too complicated and expensive for most cars. Horsepower?

"***Horsepower has gone beyond real necessity,***" he remarked to me. "There are good uses for increased horsepower, but it would be silly to say that it is needed. There has been a great deal of protest in the press, and laws may be passed to limit it. However, the car that lags behind others in extra power for passing is in trouble on the road. The other day I got into a situation where I was trailing fifteen cars. I followed the procession for five miles, holding back to find out what my reactions would be if I didn't have the power to pass. It was very frustrating, and I saw some older cars with less horsepower take some awful chances.

Coming Soon in PS: An Expert Forecast

"A great deal of power is used by automatic transmissions and other new appliances. I expect to see universal acceptance of air conditioning. If you put in a unit that will pull down temperature to comfort in 90 seconds, in a parked car on a hot day, it will add 10 percent to the power load."

Cars of the future will be of three types, Chesebrough thinks: the big highway cruiser with all the trimmings; a cheaper car for local use, adequate in size but stripped of many refinements; and "personalized transportation"—sports cars or even the utilitarian motor scooter.

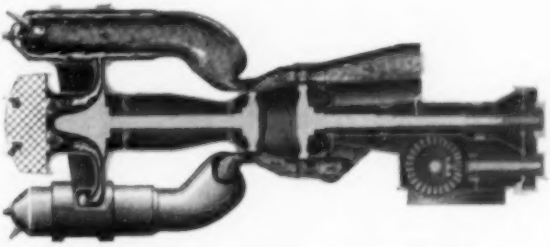


Free pistons of twin diameters bounce against an inner combustion area. The hot gases created can be ducted to a remote power-producing turbine

When you enter the door of George J. Huebner Jr., Chrysler's executive engineer for research, you take a giant step into the automotive future, if the gas-turbine zealots are correct. When he first demonstrated his pin-wheel Plymouth in 1954, he predicted that mass production was 10 years away.

True to his time schedule, he still sticks to 1964 as the date on which drivers will be able to buy a radical car with no radiator, no vibration, few moving parts, and burning kerosene or other simple fuels.

There have always been barriers in the path of this challenging beast: high fuel consumption, the need of expensive alloys for high-temperature turbine blades, a time lag in acceleration while the power turbine catches up with the compressor turbine and, less important, the lack of engine-compression braking. Huebner has been hacking away at these barriers. He greatly improved fuel economy by means of a heat exchanger. Three years ago this device was a dark mystery; now he has partially unveiled it.



A purely rotary mechanism, the gas turbine promises far greater smoothness than any reciprocating engine. And its torque is highest at stall

Experimental turbocars without heat exchangers, like Britain's pioneer Rover in 1950, exhaust great quantities of hot gas—unbearable in traffic and wasteful of fuel. But if you use exhaust gases to preheat incoming air, you beat both problems.

Huebner's heat exchanger is a shallow cylinder 30 inches in diameter and three inches high, mounted horizontally on the engine and slowly rotated by gears. Since he describes its operation as "heating a brick in the oven and then taking it out," we may assume that it is bisected vertically by a gas barrier, and that the hot exhaust gas passing through one side gives up heat to metal components that revolve through the barrier and

of What You'll Find in the 1958 Cars

preheat the incoming cold air. General Motors uses a similar rotating heat exchanger in its experimental turbocar, and Ford reportedly also has one.

Driving his turbine-powered Plymouth from coast to coast last year, Huebner averaged an overall fuel consumption of 13-14 miles per gallon of kerosene. He reports increased economy since then. As in the jet plane, the hotter the fire the more power. With every 100-degree increase in temperature there is a 10-percent rise in power output and a five-percent increase in thermal efficiency. Three years ago his engine was operating at 1,500° F; now he is getting 1,600° F. With a gas temperature of 1,650° F, this car could get more miles per gallon than today's automobile, he says. Meanwhile, General Motors turbocar engineers report that in their Firebird II, fuel consumption has been reduced to half that of their first model.

All turbocar engineers are working on new heat-resistant alloys that use little or no strategic cobalt and nickel, and the fate of the vehicle pretty much depends on their results. Huebner reports a new Chrysler alloy, used to line the burner, that will stand much more heat than stainless steel and is many times cheaper, and speaks of other new alloys in which strategic metals are reduced almost to the zero point. General Motors reports similar confidence.

The time lag in acceleration, says Huebner, can be eliminated by putting plenty of power in the engine. Other engineers have suggested mechanical devices to reduce the awkward wait. Considering today's demand for quick acceleration, the handicap must be overcome if drivers are to accept the car. As for braking, you might put the power turbine in reverse going downhill, but that uses as much fuel as hill-climbing. Air-cooled disk brakes could be the answer.

Though there are many scoffers in Detroit, motor firms have already spent from $50,000,000 to $75,000,000 on the turbocar. Some firms speak of a gradual introduction of the turbocar, with trucks and buses taking the lead; but Huebner believes that the high cost of

[*Continued on page 266*]

What Insurance Men Say About Horsepower

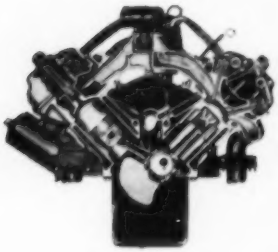
"While we have watched, in recent years, the effort to bring customers into the showroom by piling more power under the hood, we have also seen the traffic-accident rate shoot upward. The result, invariably, has been a rise in insurance costs. Like many traffic-safety people, I feel that the currently rising traffic death rate can be attributed directly to unnecessarily high-powered engines at the command of irresponsible drivers. High as they are, auto-insurance rates in the U. S. have not proven adequate to cover the expense of accidents, so rates are being hiked again. As long as accident frequency increases, policy holders will continue to take it on the chin—and the wallet."

HARRY PONTIOUS, *Safety Director, Nationwide Insurance.*

"We deplore the dramatic emphasis on speed and acceleration in automobile advertisements and TV shows. We think it has encouraged the competitive egomaniac drivers who are laws unto themselves. Highway officials believe that speed is a major accident cause. Give drivers more passing time and many of them will shave the margin and take even more chances. Across the board, faster acceleration does not contribute to safety."

TOM BOATE, *Manager, Accident Prevention Department, Association of Casualty and Surety Companies*

PS Annual Auto Buyer's Score Card



All About the '57 Cars

Under the artful sheet metal of the '57 cars is the solid engineering that makes new models really new. You'll see the details in the car-by-car specifications on the following four pages.

Where does this year's extra power come from? Some engines are just bigger—their cylinders have room for more exploding gas. Others have items such as competition camshafts and fuel injection. Compression ratios are up, now averaging 8.9:1 compared to last year's 8.5:1, for still more power—and more advantage from the new super-fuels.

Room? New step-down frames make up for the lower overall height, so there's still room for your head —an average of 35.4 inches against last year's 35.8. And your garage won't seem much tighter than before. Overall length has not changed much, and only Chrysler cars got appreciably wider—an average of 1.3 inches.

But prices . . . they're up considerably. That's the Big Picture. For individual figures, make-by-make and series-by-series, please turn the page.

All About the '57 Engines

PS AUTO BUYER'S SCORE CARD		TYPE OF ENGINE	DISPLACEMENT (cu. in.)	HORSEPOWER AT WHAT R.P.M.	HORSEPOWER PER CUBIC INCH OF DISPLACEMENT	WEIGHT PER HORSEPOWER[a] (lb.)	TORQUE (lb.-ft.) AT WHAT R.P.M.	
BUICK	Special	OHV V-8	364	250 @ 4,400	.687	16.0	380 @ 2,400	
	Century, Super, Roadmaster	OHV V-8	364	300 @ 4,600	.824	13.8	400 @ 3,200	
CADILLAC	All Series	OHV V-8	365	300 @ 4,800	.822	15.3	400 @ 2,800	
CHEVROLET	All Series	OHV 6	236	140 @ 4,200	.594	23.6	210 @ 2,400	
		OHV V-8	265	162 @ 4,400	.611	20.2	257 @ 2,400	
		OHV V-8	283	185 @ 4,600	.654	17.8	275 @ 2,400	
CHRYSLER	Windsor	OHV V-8	354	285 @ 4,600	.805	14.0	365 @ 2,400	
	Saratoga	OHV V-8	354	295 @ 4,600	.833	14.1	390 @ 2,800	
	New Yorker	OHV V-8	392	325 @ 4,600	.830	13.3	430 @ 2,800	
	300-C	OHV V-8	392	375 @ 5,200	.957	11.2	420 @ 4,000	
CONTINENTAL		OHV V-8	368	n.a.	n.a.	n.a.	n.a.	
CORVETTE		OHV V-8	283	220 @ 4,800	.777	12.2	300 @ 3,000	
DE SOTO	Firesweep	OHV V-8	325	245 @ 4,400	.754	15.0	320 @ 2,400	
	Firedome	OHV V-8	341	270 @ 4,600	.792	14.5	350 @ 2,400	
	Fireflite	OHV V-8	341	295 @ 4,600	.865	13.6	375 @ 2,800	
DODGE	Coronet	L-6	230	138 @ 4,000	.600	25.5	208 @ 1,600	
	Coronet, Royal	OHV V-8	325	245 @ 4,400	.754	14.8	320 @ 2,400	
	Custom Royal	OHV V-8	325	260 @ 4,400	.800	14.2	335 @ 2,800	
FORD	All Series	OHV 6	223	144 @ 4,200	.646	22.2	212 @ 2,400	
	Custom	OHV V-8	272	190 @ 4,500	.700	17.5	270 @ 2,700	
	Fairlane	OHV V-8	292	212 @ 4,500	.726	16.2	297 @ 2,700	
HUDSON	Hornet	OHV V-8	327	255 @ 4,700	.780	14.2	345 @ 2,600	
IMPERIAL	All Series	OHV V-8	392	325 @ 4,600	.830	14.3	430 @ 2,800	
LINCOLN	Both Series	OHV V-8	368	300 @ 4,800	.815	16.0	415 @ 3,000	
MERCURY	Both Series	OHV V-8	312	255 @ 4,600	.817	15.2	340 @ 2,600	
NASH	Ambassador	OHV V-8	327	255 @ 4,700	.780	14.3	345 @ 2,600	
OLDSMOBILE	All Series	OHV V-8	371	277 @ 4,400	.747	14.4	400 @ 2,800	
PACKARD CLIPPER		OHV V-8	289	275 @ 4,800	.952	13.1	333 @ 3,200	
PLYMOUTH	All Series	L-6	230	132 @ 3,600	.574	24.7	205 @ 1,600	
	Plaza	OHV V-8	277	197 @ 4,400	.711	17.4	270 @ 2,400	
	Savoy, Belvedere	OHV V-8	301	215 @ 4,400	.714	15.9	285 @ 2,800	
PONTIAC	Chieftain	OHV V-8	347	252 @ 4,600[h]	.726	14.6	354 @ 2,400[h]	
	Super Chief, Star Chief	OHV V-8	347	270 @ 4,800[j]	.778	13.9	359 @ 2,800[j]	
RAMBLER		OHV 6	196	125 @ 4,200	.639	23.3	175 @ 1,600	
		OHV V-8	250	190 @ 4,900	.760	17.0	240 @ 2,500	
STUDEBAKER	Champion	L-6	186	101 @ 4,000	.544	27.6	152 @ 1,800	
	Commander	OHV V-8	259	180 @ 4,500	.694	17.3	260 @ 2,800	
	President	OHV V-8	289	210 @ 4,500	.727	15.1	300 @ 2,800	
	Classic	OHV V-8	289	225 @ 4,500	.779	14.5	305 @ 3,000	
	Golden Hawk	OHV V-8	289	275 @ 4,800	.952	12.4	333 @ 3,200	
THUNDERBIRD		OHV V-8	292	212 @ 4,500	.726	14.8	297 @ 2,700	

NOTES: n.a. This information not available at press time. [a]For the lowest priced four-door sedan (or equivalent model if there is no sedan) in the series listed. [b]Requires premium fuel if equipped with automatic transmission or power pack. [c]Eldorado only. [d]Option giving highest power listed; other engines also available. [e]With Powerglide; 4.3 with Turboglide. [f]Choice of 13 ratios available.

and Transmissions

BORE AND STROKE (in.)	COMPRESSION RATIO (to 1)	FUEL REQUIRED (regular or premium)	OPTIONAL EXTRA POWER		AUTOMATIC TRANSMISSION		REAR-AXLE RATIOS (to 1)			TYPE OF DRIVE
			Horsepower	Torque	Type (torque converter or fluid coupling)	Maximum Torque Multiplication of Converter at Stall (to 1)	Automatic Transmission	Manual Transmission	Overdrive	
4.13 x 3.40	9.5	R[b]	—	—	TC	3.5	3.07	3.58	—	torque tube
4.13 x 3.40	10.0	P	—	—	TC	3.5	3.07	—	—	torque tube
4.00 x 3.63	10.0	P	325 @ 4,800[c]	400 @ 3,300[c]	FC	—	3.07	—	—	Hotchkiss
3.56 x 3.94	8.0	R	—	—	TC	2.1	3.36	3.55	4.11	Hotchkiss
3.75 x 3.00	8.0	R	—	—	—	—	—	3.55	4.11	Hotchkiss
3.87 x 3.00	8.5	R[b]	283 @ 6,200[d]	290 @ 4,400[d]	TC	2.1[e]	3.36	3.55	4.11	Hotchkiss
3.94 x 3.63	9.25	P	295 @ 4,600	390 @ 2,800	TC	2.6	3.18	3.73	—	Hotchkiss
3.94 x 3.63	9.25	P	—	—	TC	2.6	3.18	—	—	Hotchkiss
4.00 x 3.90	9.25	P	—	—	TC	2.3	3.18	—	—	Hotchkiss
4.00 x 3.90	9.25	P	390 @ 5,400	430 @ 4,200	TC	2.3	3.36	f	—	Hotchkiss
4.00 x 3.66	10.0	P	—	—	TC	2.1	3.07	—	—	Hotchkiss
3.88 x 3.00	9.5	P	283 @ 6,200[d]	290 @ 4,400[d]	TC	2.1	3.55	3.70	—	Hotchkiss
3.69 x 3.80	8.5	R[b]	260 @ 4,400	335 @ 2,400	TC	2.7	3.54	3.91	—	Hotchkiss
3.78 x 3.80	9.25	P	—	—	TC	2.7	3.36	3.91	—	Hotchkiss
3.78 x 3.80	9.25	P	—	—	TC	2.7	3.36	—	—	Hotchkiss
3.25 x 4.63	8.0	R	—	—	TC	2.6	3.73	3.90	—	Hotchkiss
3.69 x 3.80	8.5	R[b]	310 @ 4,800[d]	350 @ 3,200[d]	TC	2.6	3.54[g]	3.73	—	Hotchkiss
3.69 x 3.80	8.5	P	310 @ 4,800[d]	350 @ 3,200[d]	TC	2.6	3.36	3.73	—	Hotchkiss
3.62 x 3.60	8.6	R	—	—	TC	2.1	3.10	3.70	3.89	Hotchkiss
3.62 x 3.30	8.6	R[b]	245 @ 4,500	332 @ 3,200	TC	2.1	3.10	3.56	3.70	Hotchkiss
3.75 x 3.30	9.1	R[b]	245 @ 4,500	332 @ 3,200	TC	2.1	3.10	3.56	3.70	Hotchkiss
4.00 x 3.25	9.0	P	—	—	FC	—	3.15	4.10	4.10	torque tube
4.00 x 3.90	9.25	P	—	—	TC	2.3	3.18	—	—	Hotchkiss
4.00 x 3.66	10.1	P	—	—	TC	2.1	3.07	—	—	Hotchkiss
3.80 x 3.44	9.7	P	290 @ 4,600	405 @ 2,800	TC	2.1	2.91	3.70	3.89	Hotchkiss
4.00 x 3.25	9.0	P	—	—	FC	—	3.15	4.10	4.10	torque tube
4.00 x 3.69	9.5	P	—	—	FC	—	3.23	3.64	—	Hotchkiss
3.56 x 3.63	7.8	P	—	—	TC	2.15	3.31	—	4.27	Hotchkiss
3.25 x 4.63	8.0	R	—	—	TC	2.6	3.73	3.73	4.10	Hotchkiss
3.75 x 3.13	8.0	R[b]	235 @ 4,400	305 @ 2,800	TC	2.7	3.54	3.54	3.91	Hotchkiss
3.91 x 3.13	8.5	R[b]	235 @ 4,400	305 @ 2,800	TC	2.7	3.54[g]	3.54	3.91	Hotchkiss
3.94 x 3.56	10.0[i]	P[i]	317 @ 5,200	359 @ 3,600	FC	—	3.08	3.42	—	Hotchkiss
3.94 x 3.56	10.0[i]	P[i]	317 @ 5,200	359 @ 3,600	FC	—	3.08	3.42	—	Hotchkiss
3.13 x 4.25	8.25	R	135 @ 4,500	180 @ 1,800	FC	—	3.31	3.77	4.40	torque tube
3.50 x 3.25	8.0	R	—	—	FC	—	3.54	4.10	4.40	torque tube
3.00 x 4.38	7.8	R	—	—	TC	2.15	3.54	4.10	4.56	Hotchkiss
3.56 x 3.25	8.3	R	195 @ 4,500	265 @ 3,000	TC	2.15	3.31	3.54	3.92	Hotchkiss
3.56 x 3.63	8.3	R	225 @ 4,500	305 @ 3,000	TC	2.15	3.31	3.54	3.92	Hotchkiss
3.56 x 3.63	8.3	R	—	—	TC	2.15	3.31	3.54	4.09	Hotchkiss
3.56 x 3.63	7.5	P	—	—	TC	2.15	3.31	—	3.92	Hotchkiss
3.75 x 3.30	9.1	R[b]	245 @ 4,500	332 @ 3,200	TC	2.1	3.10	3.56	3.70	Hotchkiss

[a]With PowerFlite; 3.36 with TorqueFlite. [b]With Hydra-Matic; cars with manual shift deliver 227 hp. @ 4,600 r.p.m., 333 lb.-ft. @ 2,300 r.p.m. [c]Cars with manual shift use regular fuel at 8.5:1 compression ratio. [d]With Hydra-Matic; cars with manual shift deliver 244 hp. @ 4,800 r.p.m., 338 lb.-ft. @ 2,700 r.p.m.

other engines also available. [c]With Powerglide; 4.3 with Turboglide. [f]Choice of 13 ratios available.

All About the '57 Chassis

PS AUTO BUYER'S SCORE CARD		WHEELBASE (in.)	OVERALL LENGTH (in.)	WIDTH (in.)	WEIGHT[a] (lb.)	WEIGHT PER SQ. IN. BRAKE-LINING AREA	OVERALL STEERING RATIO		TURNING CIRCLE DIA. (curb, to curb—ft.)	TIRE SIZE
							Manual	Power		
BUICK	Special, Century	122.0	208.4	74.8	4,012	23.2	28.8	19.6	43.2	7.10 x 15[c]
	Super, Roadmaster	127.5	215.3	77.6	4,356	25.2	—	19.6	44.5	7.60 x 15[d]
CADILLAC	Series 62	129.5	215.9	80.0	4,595	21.9	—	19.5	43.4	8.00 x 15
	Series 60	133.0	224.4	80.0	4,755	22.6	—	19.5	45.0	8.00 x 15
	Eldorado	129.5	222.1	80.0	4,810	22.7	—	19.5	43.4	8.20 x 15
	Series 75	149.8	236.2	80.0	5,340	22.8	—	19.5	51.7	8.20 x 15
CHEVROLET	150, 210, Bel Air	115.0	200.0	73.9	3,265	20.08	25.7	23.3	41.5	7.50 x 14
CHRYSLER	Windsor, Saratoga, New Yorker	126.0	219.2	78.8	3,995	15.9	29.9	19.8	45.3	8.50 x 14[f]
	300-C	126.0	219.2	78.8	4,190	16.7	29.9	19.8	45.3	9.00 x 14
CONTINENTAL	Mark II	126.0	218.4	77.5	4,800	23.1	—	20.9	45.3	8.00 x 15
CORVETTE		102.0	169.0	70.5	2,675	17.0	16.0	—	36.9	6.70 x 15
DE SOTO	Firesweep	122.0	215.8	78.2	3,675	16.0	26.8	19.8	43.8	8.00 x 14
	Firedome, Fireflite	126.0	218.0	78.2	4,005	15.6	29.9	19.8	45.3	8.50 x 14
DODGE	Coronet, Royal, Custom Royal	122.0	212.2	77.9	3,620	17.5	26.8	19.8	43.8	7.50 x 14[m]
FORD	Custom	116.0	201.7	77.0	3,334	18.4	27.0	27.0	40.1	7.50 x 14
	Fairlane	118.0	201.7	77.0	3,437	19.1	27.0	27.0	40.6	7.50 x 14
HUDSON	Hornet	121.3	209.3	78.0	3,631	18.4	25.4	23.1	42.0	8.00 x 14
IMPERIAL	Imperial, Crown, LeBaron	129.0	224.0	81.2	4,640	18.5	—	19.8	49.5	9.50 x 14
LINCOLN	Capri, Premiere	126.0	224.6	80.3	4,722	22.7	—	20.9	45.5	8.00 x 15
MERCURY	Monterey, Montclair	122.0	211.1	79.1	3,890	18.3	27.0	27.0	43.3	8.00 x 14
NASH	Ambassador	121.3	209.3	78.0	3,639	18.2	25.4	23.1	42.0	8.00 x 14
OLDSMOBILE	"88", Super "88"	122.0	208.2	76.4	4,000	20.8	27.3	22.7	42.0	8.50 x 14
	Ninety-Eight	126.0	216.7	76.4	4,347	22.6	—	22.7	43.0	8.50 x 14
PACKARD CLIPPER		120.5	211.8	76.9	3,600	18.4	—	18.2	41.0[n]	7.60 x 15
PLYMOUTH	Plaza, Savoy, Belvedere	118.0	204.6	78.2	3,420	18.6	26.8	19.8	42.4	7.50 x 14
PONTIAC	Chieftain, Super Chief	122.0	206.8	75.2	3,670[o]	20.6	25.0	22.5	42.5	7.50 x 14[p]
	Star Chief	124.0	213.8	75.2	3,740[o]	21.0	25.0	22.5	43.0	8.00 x 14
RAMBLER	V-8	108.0	191.1	71.3	3,223	21.4	23.0	17.2	37.5	6.70 x 15
STUDEBAKER	Champion, Commander, President	116.5	202.4[r]	75.8	3,105	16.0	24.5[s]	18.2	39.5	6.70 x 15[t]
	Classic	120.5	206.4	75.8	3,270	16.0	24.5	18.2	41.0	7.10 x 15
	Golden Hawk	120.5	203.9	71.3	3,400	17.4	24.5	18.2	41.0	7.10 x 15
THUNDERBIRD		102.0	181.4	72.8	3,134	17.8	23.0	23.0	35.0	7.50 x 14

NOTES: n.a. This information not available at press time. [a]For the lowest-priced four-door sedan (or equivalent model if there is no sedan) in the series listed. [b]All prices include Federal excise tax and preparation and handling charges, but no other taxes or shipping charges. Base price applies to the least expensive four-door sedan (or equivalent model if there is no sedan), without any optional equipment, in each series. [c]7.60 x 15 on Century. [d]8.00 x 15 on Roadmaster. [e]Seating arrangement not comparable to other cars. [f]For Powerglide; Turboglide ($231) is available only with V-8 engine. [g]This air

hp. @ 4,600 r.p.m., 333 lb.-ft. @ 2,300 r.p.m. [i]Cars with manual shift use regular fuel at 8.5:1 compression ratio. [j]With Hydra-Matic; cars with manual shift deliver 244 hp. @ 4,800 r.p.m., 338 lb.-ft. @ 2,700 r.p.m.

and Prices

LEG ROOM (in.)		HEADROOM (in.)		HIP ROOM (in.)		PRICE[b]						
Front	Rear	Front	Rear	Front	Rear	Base (8-cyl. engine)	Automatic Transmission	Power Steering	Power Brakes	Air Conditioning	Radio	Heater
43.4	42.4	34.8	33.3	62.5	62.2	$2,660	$220	$108	$39	$430	$100	$91
						3,234	standard	108	39	430	100	91
44.0	45.0	35.8	35.0	65.5	65.0	3,681	standard	standard	39	430	100	91
						4,053	standard	standard	39	430	100	91
45.0	45.2	35.0	34.9	65.2	65.0	4,713	standard	standard	standard	474	164	129
45.2	45.3	33.9	34.7	65.0	65.0	5,539	standard	standard	standard	474	164	129
44.5	39.9	35.5	34.0	65.7	57.3	7,218	standard	standard	standard	474	standard	standard
43.5	e	36.6	35.3	65.5	57.8	7,348	standard	standard	standard	587	246	179
44.7	39.8	36.0	35.6	62.1	63.0	2,148	188[f]	70	38	430[c]	66[h]	48
						2,274	188[f]	70	38	430[c]	66[h]	48
						2,390	188[f]	70	38	430[c]	66[h]	48
45.5	43.0	34.8	34.6	63.0	62.7	3,030	220	108	40	506[j]	100	86
						3,660	standard	standard	40	506[j]	100	86
						4,118	standard	standard	40	506[j]	100	86
45.5	38.0	34.1	34.0	63.0	56.0	n.a.	standard	standard	standard	506[j]	100	86
42.5	39.1	35.1	34.6	59.6	56.6	9,695	standard	standard	standard	685[k]	standard	standard
44.2	—	34.3	—	e	—	3,465	188	—	—	—	199	118
45.5	43.0	34.8	34.6	63.0	62.7	2,679	180[i]	106	39	493[j]	94	85
45.5	43.0	34.8	34.6	63.0	62.7	2,897	220	106	39	493[j]	94	85
						3,426	standard	106	39	493[j]	94	85
45.5	42.5	34.8	34.2	63.0	62.7	2,517	180[i]	92	38	459[j]	67	80
						2,656	220	92	38	459[j]	67	80
						2,826	220	92	38	459[j]	67	80
44.3	41.8	34.9	33.6	60.3	60.3	2,104	180	69	37	413	74	45
43.2	40.7	33.9	33.6	60.0	60.1	2,348	180	69	37	413	74	45
42.5	40.1	36.4	35.3	65.0	64.5	2,750	232	100	40	415[j]	90	83
46.5	38.5	36.0	34.6	63.5	63.2	4,764	standard	standard	standard	590[j]	170	127
						5,325	standard	standard	standard	590[j]	170	127
						5,656	standard	standard	standard	590[j]	170	127
44.8	42.5	35.4	34.1	61.7	63.8	4,662	standard	standard	standard	540[j]	153	136
						5,162	standard	standard	standard	540[j]	153	136
44.2	41.4	33.9	33.5	61.3	62.9	2,605	226	86	38	430[j]	100	91
						3,148	standard	86	38	430[j]	100	91
42.5	40.1	36.4	35.3	65.0	64.5	2,750	232	100	40	415[j]	90	85
44.4	41.8	35.3	33.8	62.5	62.2	2,756	231	107	40	400	96	85
						2,988	231	107	40	400	96	85
44.2	41.8	34.8	33.4	62.3	62.0	3,691	standard	standard	standard	400	96	85
44.0	41.0	36.5	35.5	59.5	59.0	n.a.	n.a.	standard	n.a.	n.a.	n.a.	n.a.
45.9	41.5	35.3	34.2	63.0	62.7	2,100	180	84	38	446[j]	69	69
						2,239	180	84	38	446[j]	69	69
						2,355	180[i]	84	38	446[j]	69	69
43.4	42.0	35.8	35.8	61.9	63.1	2,524	231	108	39	431	98	91
43.4	41.8	35.8	35.8	61.9	63.1	2,650	231	108	39	431	98	91
						2,813	231	108	39	431	98	91
43.0	42.0	36.0	35.0	59.8	60.1	2,195	232[n]	60	36	362[j]	70	76
42.5	39.0	36.5	35.5	59.5	59.0	2,049[o]	189	98	38	—	61	71
						2,173	189	98	38	395	61	71
						2,407	189	98	38	395	61	71
42.5	41.0	36.5	35.5	59.5	59.0	2,539	189	98	38	395	61	71
43.8	36.0	35.6	34.0	59.5	e	3,182	119	98	38	395	61	71
44.9	—	33.1	—	58.8	—	3,367	215	64	38	—	114	84

conditioner, which includes a heater, is available only on cars having V-8 engines and automatic transmissions. [b]Installation and tax extra. [c]9.00 x 14 on New Yorker. [d]Includes a heater. [e]Price does not include excise tax or handling charges. [f]For PowerFlite; TorqueFlite costs $220. [m]8.00 x 14 on Royal and Custom Royal. [n]Wall-to-wall. [o]With Hydra-Matic. [p]8.00 x 14 on Super Chief. [q]$188 with six-cylinder engine. [r]200.8" on President. [s]21.5 on Champion. [t]6.40 x 15 on Champion. [u]With six-cylinder engine.

How Lincoln Modernized the Science of War

TRYING out a new weapon was as much a part of the Civil War for Abraham Lincoln as trying out a new general. He substituted one general for another till he found his winners. He did the same thing with weapons.

When the war began in 1861, soldiers of both North and South used single-shot, muzzle-loading muskets; they fired round balls from erratic, smooth-bore cannon; and their cavalry charged with drawn sabers. When the war ended in 1865, soldiers of the North fired repeating, breech-loading rifles; their cannon accurately hurled high-explosive shells; and their cavalry fought with seven-shot breech-loading carbines.

Lincoln's government issued over 16,000 patents against the South's 266. This lopsided score by itself may have determined the outcome of the war. Lincoln never stopped talking to inventors, encouraging them, watching their devices tested. Of inventors, he said: "They don't want much; they get but little, and I must see them." Says Robert V. Bruce, in *Lincoln and the Tools of War*, "He was the nearest thing the Union had to a research and development agency."

When Lincoln left Illinois for Washington, he was known as a capable handyman—"practical mechanic" it was called then. Pictures on these pages show how this "practical mechanic," before the Civil War was over, had helped develop, at least in crude form, almost every weapon known today—except the split atom.—*Gardner Soule.*

AMATEUR INVENTOR In his backwoods youth, Lincoln learned to be handy with both gun and tools. He killed a wild turkey with one shot at the age of eight, soon showed great skill with ax, knife and saw. After two trips on river boats, he patented a device with stilts and buoyancy chambers that was intended to help a boat over shoals. But nothing ever came of his invention.

BREECH-LOADERS In 1861, Lincoln tried two breech-loading rifles in a weed patch near the White House. They convinced him. To load muzzle-loaders, soldiers had to stand up, thus becoming targets; breech-loaders could be loaded prone. When Col. James Wolfe Ripley, Army Ordnance Chief, protested they couldn't be produced in time, Lincoln ordered him to get them anyway.

SIGNAL LIGHTS Scarcely had Lincoln reached war-jittery Washington as President when Joseph Henry, of the Smithsonian Institution, took him to see new blinker-equipped calcium lights flash Morse-code messages between the Smithsonian and the Soldiers' Home. An agitated citizen rushed to Lincoln with tales of Rebel signals overhead. Lincoln smiled and put his mind at ease.

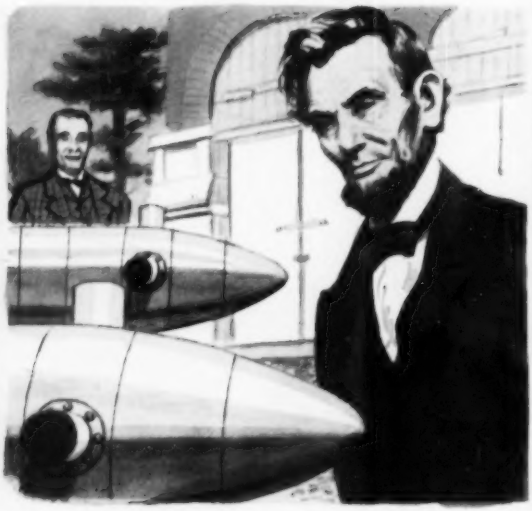
AN "AIR FORCE" In June, 1861, the war led T. S. C. Lowe, an air-minded Yankee from New Hampshire, to propose balloons for reconnaissance. Lincoln was enthusiastic, prodded Gen. Winfield Scott into getting seven. A ship (the first "aircraft carrier") bore one in the Potomac. Locomotives hauled others. Via telegraph lines to ground, balloons provided useful information in two battles.

NEW CARBINE In June, 1861, Lincoln whittled a gunsight for the Spencer carbine, then hit a small target with the long-range gun—a seven-shot repeater that could also be built rifle-length. Ripley said men could be killed with the old muskets. "Just so," replied Lincoln, "but our folks are not getting near enough to the enemy." He told Col. Ripley to put in an order for 10,000 Spencers.

MACHINE GUN Also in 1861, Lincoln turned a crank that fed cartridges to a rapid-fire weapon he named the "coffee-mill gun." Col. Ripley had "no opinion . . . without further trials," which he did not order to take place. Lincoln bought 10 of the "coffee mills" on his own. In March '62, at Middleburg, Va., the guns made their debut, putting startled Southern cavalry to flight.

For more Civil War inventions, please turn the page

MORTAR BOATS Lincoln counted on boats carrying mortars to win Southern rivers. Discovering that no one was getting the mortars built, he demanded daily progress reports. Soon, 13-inchers were en route to Grant on railroad cars marked "Not to be switched under penalty of death." The "chowder pots" helped take a Mississippi island, later helped in the capture of New Orleans.



ROCKET TORPEDO A man named Pascal Plant proposed a rocket-driven submarine torpedo. Admiral Dahlgren, who helped Lincoln develop weapons, had several made and fired. One veered and plowed into the harmless little schooner Diana anchored nearby—making it the first ship sunk by a self-propelled torpedo. But the Navy couldn't develop control of the torpedoes during the war.

REPEATERS By 1863, Lincoln's repeating, breech-loading rifles and carbines were revolutionizing warfare. At battles of Mechanicsville, the Chickahominy, and Antietam, they took heavy toll on the Confederacy and boosted the morale of Northern troops. Outfits armed with Spencer carbines now "expected to win." Gen. George Thomas said of the carbine: "The most effective weapon in use."

RIFLED CANNON Lincoln had insisted on rifled cannon. Ordnance Chief Ripley had been dubious about trying them. Again, Lincoln's judgment was sound. The new cannon soon made its name. It hurled shells (not balls), hurled them straight (not wobbly) because rifling imparted a spin to the shell. Rifled cannon leveled Fort Pulaski, chief defense of Savannah, other Southern forts.

IRON-CLADS Lincoln heard reports that the Confederacy was rebuilding the wooden frigate Merrimac into an iron-clad warship. He backed John Ericsson's plans for armoring the Monitor to oppose her. The Merrimac sank five Federal wooden frigates before pounding from the Monitor's 11-inch guns drove her back to Norfolk and out of the war. From then on, warships with wooden walls were obsolete.

INCENDIARY SHELLS Lincoln arranged—and watched from a White House window—a demonstration of Levi Short's "Greek fire." Two incendiary shells tossed fire 40 feet into the air and carpeted the ground with flames over a 50-foot radius. Ordnance Chief Ripley wasn't interested in buying. But some incendiaries nevertheless were ordered, later set fire to Vicksburg and Charleston.

JULY 2, 1863 On the second day at Gettysburg, Confederate Gen. Longstreet's men ran into 100 sharpshooters, armed with repeating rifles, who fired 95 rounds each in 20 minutes. Bullets came so thick the Rebs thought they were facing two regiments. Longstreet was delayed 40 minutes. Had it been 35, Longstreet might have won the battle. Gettysburg was the war's turning point.

SPRING 1865 On April 9, Lee surrendered. On April 14, Lincoln was assassinated by John Wilkes Booth. The killer used an antiquated derringer pistol that fired only one ball. But when Federal pursuers caught and killed Booth in a barn 12 days later, he was armed for self-defense with a Spencer carbine—a superior gun manufactured only at the insistence of Abraham Lincoln. END

Running the World's Fastest Railroad

A high-speed camera couldn't

French trains don't hit a record 206 m.p.h. every day, but by smart railroading they do carry huge passenger loads at high speeds

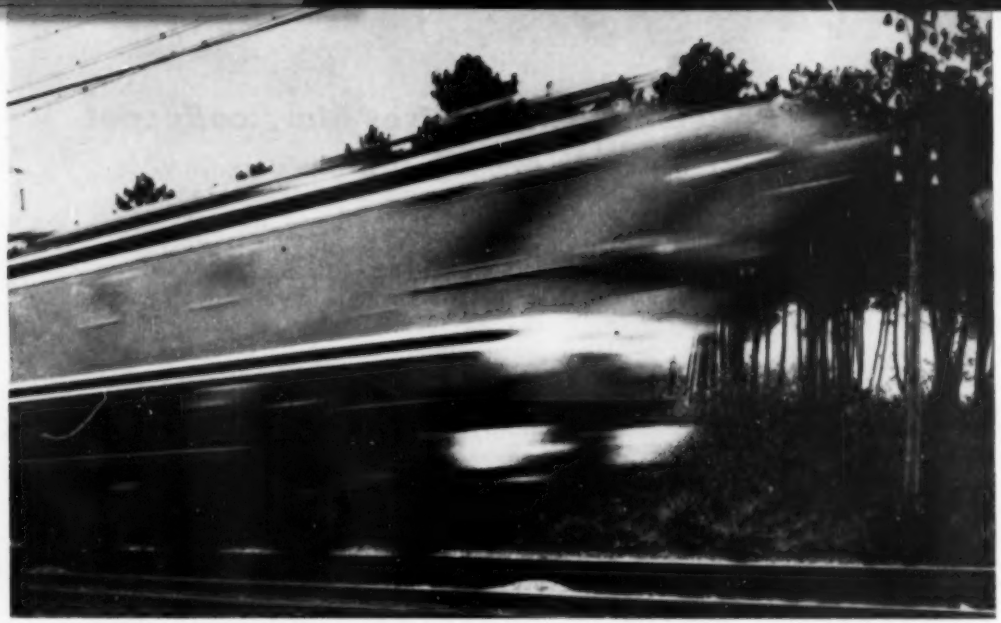
By René Lecler

ON THE morning of March 29, 1955, at a small railroad station south of Bordeaux, Chief Engineer Fernand Nouvion climbed into the cab of a French National Railways electric locomotive. He tapped the regular engineer, Henri Brachet, on the shoulder and said: "*Allons-y*" (Let's go). The huge motors, totaling 4,000 hp., hummed to full power and the locomotive, bright in her new Nile-green paint, started to gather speed, pulling three passenger coaches sealed together into a single streamlined mass.

HUMMING WITH POWER, the speediest locomotive in the world eases a string of passenger cars out of Paris. Wire screening, removed here, guarded the front windows on the record run.

Three minutes later the needle of the speedometer pointed to 137 m.p.h. The rails, curveless for 50 miles through flat country, sang a song of speed and power. Then, as the train whooshed through Yehoux, a small station along the way, the speedometer read 206 m.p.h. The French engine had pulled a train at 100 yards per second and broken the world's rail speed record.

THIS spectacular accomplishment is but a small part of the realization of a man's dream. His name is Louis Armand and he is president of the *Société Nationale des Chemins de Fer Français.* It has been said of him that he has the same effect upon men as a cyclotron upon the atom: He releases the energy they contain. Because of Armand's tenacity and vision France's railroad system is not only the fastest, safest and most punctual in Europe, but it is in the vanguard of the world-wide search for the push-button trains of tomorrow.



stop the big electric locomotive. It also outpaced a photographer's plane flying overhead.

Armand has always believed in the future of railroading. He knows that in France, as in the rest of heavily populated Europe, the railroad remains the cheapest, and often the quickest, way to carry people and freight. French railroads carry over 500 million passengers a year. United States railways serving a population four times larger than France carry 486 million. One especially busy day last winter, 54 fast passenger trains covered the 320-mile Paris-Lyon stretch between six p.m. and midnight—one express every 6½ minutes.

It was during World War II that Armand planned his pioneering railroad. Head of the National Railways' southeastern region at the time of the Nazi occupation, he was the active leader of *Resistance-Fer*—the underground movement of French railwaymen that did everything possible to disrupt Nazi rail transportation: sending channel-bound Nazi trains to the Pyrénées by a quick flick of a lever at dead of night, blowing up bridges or losing thousands of boxcars in the vastness of the French countryside.

Ultimately Armand was arrested and locked up in Fresnes Prison. There he had a lot of time to think. "If a child's toy train can be run from a little black box," he argued with himself, "why can't the real thing be run in the same way?"

AT THE war's end he had a chance to work out the answer to this and other questions when he was named president of the railway system. French railroads were in a sorry state. Bombs had wrecked the freight yards, strategic bridges were down everywhere, and rolling stock was scattered as far away as Bulgaria. What was left of the system was burdened with a tradition-loving bureaucracy.

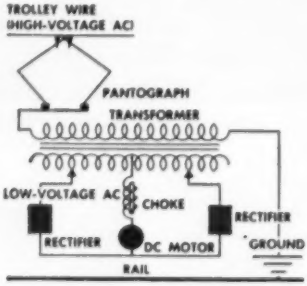
Today French railroads carry 20 percent more travelers and 76 percent more freight than in 1938, with a planned labor-force decrease of 150,000 men. Coal consumption is down from 11 million tons to 4½. Forty percent of France's main tracks have been electrified.

Since one red-letter day in 1952, when, for the first time in history, all French trains arrived at their destination on time, punctuality has become a byword. Today 97 percent of French trains reach their last stop within 15 minutes of the advertised time as against a general European average of 78 percent. Although

An American invention gives him "coffeepot

the safety record of the French railways is the best in Europe, the speed of France's trains has become proverbial. The Mistral, a crack express, races its 16 stainless-steel, air-conditioned passenger cars between Paris and Lyon at the world's fastest average for that distance, 77.6 m.p.h. The Sud-Express links Paris with Bordeaux in five hours flat at 64 m.p.h. Expresses now travel from Paris to 100 cities in France at an average speed of 62 m.p.h.

As far as possible, European countries use electricity to power their railroads. Generated by water power, it is cleaner, more plentiful than coal, and cheaper in Europe than diesel fuel. But Armand's railroads use electricity with a difference. Others run their trains on expensive, 1,500-volt DC, which requires heavy transmission lines and numerous elaborate transformer stations along the track. In contrast, Armand uses the same AC used in the home. "Coffeepot current," he calls it. He converts it to the necessary DC aboard the locomotive itself, with an American invention, the ignitron, which came into use during the war.



THE IGNITRON, a heavy-duty rectifier, allows easily controlled DC driving motors to be mated with efficient AC transmission.

ARMAND first saw an ignitron while visiting a Pittsburgh manufacturing plant shortly after the war. In the United States, there was little need for it, since most American railroads are dieselized. He immediately thought of applying it to European railways, however. "Can I put one of these aboard a locomotive?" he asked. The answer was a hesitant "Yes—in principle." Back in Paris, he chose the oldest engine he could find in the suburban service, equipped it with an ignitron, and dispatched it to the electrified Savoie mountain lines. The old locomotive with its ignitron is still in faithful service today.

By putting a new invention to unconventional use, Armand had solved a major problem. With the ignitron, he needs only one small sub-station every 40 miles instead of every seven. And the ignitron enables Armand and his colleagues to cut the weight of their locomotives from an original 140 tons to 80 tons, and the number of trucks underneath from six to four.

Some experts doubted that such light locomotives would pull. Then Armand gave his answer: In 1955 he inaugurated the world's first heavy-duty railroad system to run on AC, from Valenciennes to Thionville. Huge trains of iron ore from the Lorraine fields were pulled with complete success. In a single, 24-hour round of operations, the line carried a payload of 100,000 tons.

RECENTLY, in a small freight yard of this line, I watched one of Armand's new light engines perform. It pulled 39 loaded coke cars weighing 2,700 tons with seemingly less effort than it takes to put a motor car into gear—starting from a standstill on a 10-percent grade. With a steam engine, the heaviest load carried on this gradient had been only 1,400 tons. This triumph of the French railroader's ingenuity has been studied by experts from many nations.

Armand's technical inclination dates back to his childhood. He was born 52 years ago, the son of the schoolteacher of Cruseilles, a small Savoie mountain village. The family's best friend was the local chemist. Impressed by young Louis' unusually imaginative mind, the friend took the boy after hours to his makeshift laboratory in the back of his shop. There, under a gas lamp, the two of them carried out experiments and

current" to pull his trains

studied scientific books. As a result, when Armand entered Paris' famed Ecole Polytechnique, he was already fully acquainted with the first two years of the institute's physics program.

LATER he went to work on a railroad and attracted industry-wide attention by developing a process that prevented the scaling of locomotive boilers. It came to be used in time on all French steam engines and was patented in England and Spain.

In spite of the years that have gone by, Armand is as full of pioneering zest as ever. In common with those of other European countries, French railways were state controlled long before the present wave of nationalization. But Armand runs his enterprise with emphasis on personal initiative. "No state subsidy," he says, "should ever be given to maintain the status quo in any industry. Subsidies, if taken at all, should be used only to improve, experiment and develop."

This attitude of its boss has put the French railroads in the vanguard of the search for the train of tomorrow. Armand has electrified more than the lines, he has electrified the system itself, and the people who run it, with his personality. The huge desk in Louis Armand's vast office in the Rue St. Lazare in Paris is rarely occupied. Mostly, Armand sits by a round conference table, talking, arguing, putting enthusiasm and the holy fire of achievement into his colleagues.

Physically he is unimpressive. Of medium height, he holds himself badly before an audience. But as he begins to speak his eyes light up, his fighting chin juts forward and his index finger jabs at the air. Verbally picking up the challenge of a great problem, he reduces it to its simplest minimum with astonishing lucidity and eager enthusiasm—a zest that seems to give new horizons to the business of railroading.

Three weeks after Armand's locomotive broke the world's speed record, a

BIG BOSS of the French railways, Louis Armand works full throttle at the job of building up the system that, as a member of the Resistance during the last war, he helped to blow up.

sister engine pulled a five-coach train for 12 miles on the track to Le Mans at a speed of 78 m.p.h. The only strange thing about this trip was that there was no engineer in the cab; it was the world's first pilotless train. Electronic commands relayed from a distant control room made it stop and start at will, gather speed and slow down before signals. It was Armand's little black box come true.

"Of all forms of transportation," Armand says, "the train, being guided by rails, is best suited for automation."

TO ILLUSTRATE this point further, he sent me to a small room in the Montereau station where a lone dispatcher sitting at a small table was routing 400 trains by remote control. The dispatcher orders and an electronic "brain" executes. If an order cannot be made with safety, because of operating conditions, the brain says "no" by winking its red eye. It remembers the order, however, and acts on it as soon as possible. French railroads now have a score of such electronic control points. One at Marseille replaces 54 dispatchers.

Now French experts believe that only time and a possible popular prejudice stand in the way of a pilotless railroad. They are already carrying out experi-

His next step: an international railroad?

ments in freight yards with ghost shunting engines tele-commanded from a central point.

At Villeneuve-St. Georges, one of Europe's largest freight yards, 4,500 freight cars arrive every day from all parts of France to be uncoupled, sorted and directed into one of the 46 tracks from which a newly made train will go to its destination. With automation, this extremely complex operation is carried out by no more than five men.

THE range of ideas and gadgets applied by Armand affects all the operations of French railroads. The welded rail is being extensively installed. It puts an end to the sound produced by wheels passing over the rail joints. Each rail is welded to its neighbor over a length of 2,600 feet. To the traveler, the difference is astonishing: His train glides along noiselessly.

New equipment designed for safety and comfort is being added all the time. One such piece of equipment is called the pendulum car. It is supported by upright steel rods running directly from the undercarriage, thus swinging the car free, like a hammock. With this new car, which gives the pleasant illusion of riding on air, the official speed limit of trains is being increased to 100 m.p.h.

Despite the fact that progress has been faster than anyone thought possible, the French railroad chief still is not satisfied. For generations, European prejudices decreed that the trains of one nation should not cross another's frontier. In Armand's view, the railroad has an international vocation: to link, not to keep apart. And so, Armand is now president of the *Union Internationale des Chemins de Fer*. Fired by his eloquence at a conference 4½ years ago, 10 Western European countries are actively integrating their national railroad systems. Eighteen months ago, a man in the uniform of the *Deutsches Bundesbahn* drove the crack Ruhr Express from Dortmund right into Paris. His was perhaps the first German uniform seen in France since the end of World War II. It was Armand's work. This year will see the beginning of a service known as the Trans-Europ Express that will link all Western European capitals.

Already from Bordeaux to Copenhagen and from Amsterdam to Vienna, 170,000 freight cars carry the nameplate *Europ* in addition to their national markings. They can be sent anywhere, used

[Continued on page 276]

Electrification Is on the Wane in America

The present U.S. trend is decisively away from electric railroads. In the past decade, more than 600 route miles, involving 1,350 miles of track, have dropped "juice" operation. Total number of working electric locomotives has fallen from more than 700 to less than 500.

Our oil-powered economy is an important factor in the cutback. The 25,923 diesel units that have replaced all but 4,250 steam locomotives have also taken their toll of the electrics. New ventilation systems permit the use of diesels in tunnels and terminals that once called for electrification. Operating economies appear to result from maintaining just one basic type of locomotive, and from elimination of electric-transmission systems.

Want Better Music from Your Hi-Fi System?

The right speaker setup is vitally important to your high-fidelity system. POPULAR SCIENCE *has gathered together the latest data on 129 speakers—from tweeter to squawker to woofer—and wrapped it all up in a comprehensive article in this issue. Read "How to Choose the Right Loudspeaker" on page 196.*

Picture News
IN THE WORLD OF SCIENCE

Atomic Sub's Hull Is Assembled a Slice at a Time

A SLICE of the biggest submarine ever built, this cylinder will be welded to others like it to form part of the inner hull of the USS Triton, first of a new radar picket class. General Dynamics men rotate the cylinders while stationary welding machines join them. With spokelike supports removed, the inside surface of the cylinder will be the atomic sub's interior wall. Exterior plates will be welded atop outer ribs.

A Mighty Air Armada Poses for Its Picture

SLEEK supersonic fighters and the eight-jet, globe-girdling B-52 atom bomber were among those present when the roll of Air Force planes was called recently on the flight line at Eglin Air Force Base, Fla. A dramatic demonstration of air firepower had been opened by thunderous sonic booms from a flight of F-100 Super Sabrejets diving down above the

crowd from over 40,000 feet. Sharing the spotlight with the jets in an after-the-show display were slower, less glamorous, though equally essential, members of the flying team, proving that the propeller is not yet obsolete. Of the jets shown, the latest to join the Air Force is the B-66 tactical bomber. Key to prefix letters in identifications above: B—bomber; F—fighter or interceptor; C—cargo or transport; H—helicopter; K—tanker; R—reconnaissance; S—search-rescue; T—trainer.

Four Blue Angels Make Like One with a Multiple Tail

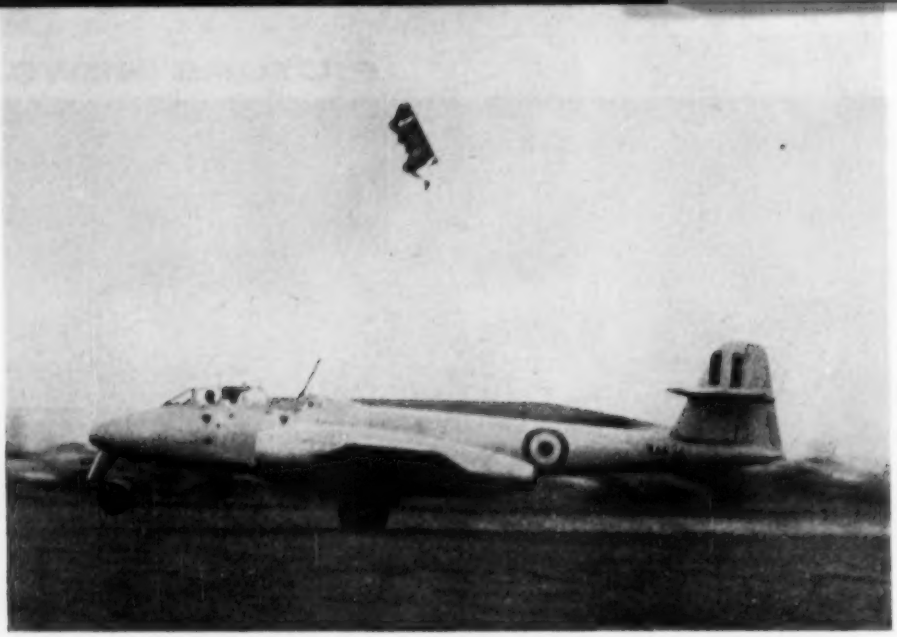
THIS is no experimental jet with three extra tails to flip it past sonic shock waves, but a tight formation of four Grumman Cougars caught at an unusual angle by a camera shooting through the canopy of a nearby jet trainer. Piloted by Blue Angels, the Navy's crack flying team, the F9F-8s were put through their paces at a Pensacola Air Station show.

Atomic Flashlight Shines Without Battery or Bulb

A RADIOACTIVE chemical product of nuclear reaction, sealed in simple containers, provided light for taking the photograph of the map above. Developed for military and other experimental use by New England Nuclear Corp., these flashlights lose only half their brightness in 12 years.

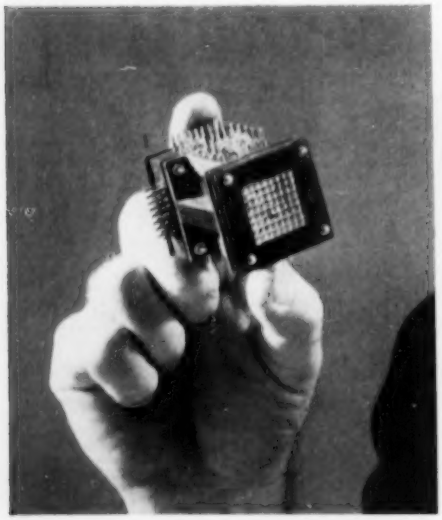
Tiny Diodes Get Ear Test Before Helping to Guide Falcon

SEMICONDUCTORS, for installation in the guidance system of an Air Force Falcon missile, are tested here with a diode orientor which indicates audibly and visually the position of the germanium crystal and direction of current. The photo was taken from under a glass-top table.



Low-Down Trick: This Pilot Bails Out from the Ground

In a test to determine the safety of automatic ejection seats at low altitudes, Squadron Leader J. S. Fifield of the RAF set a record that may be tied but will never be beaten. He was hurled—and survived unharmed—from a jet speeding along a runway. He is shown here still going up, before separation from the seat and opening of the parachute.

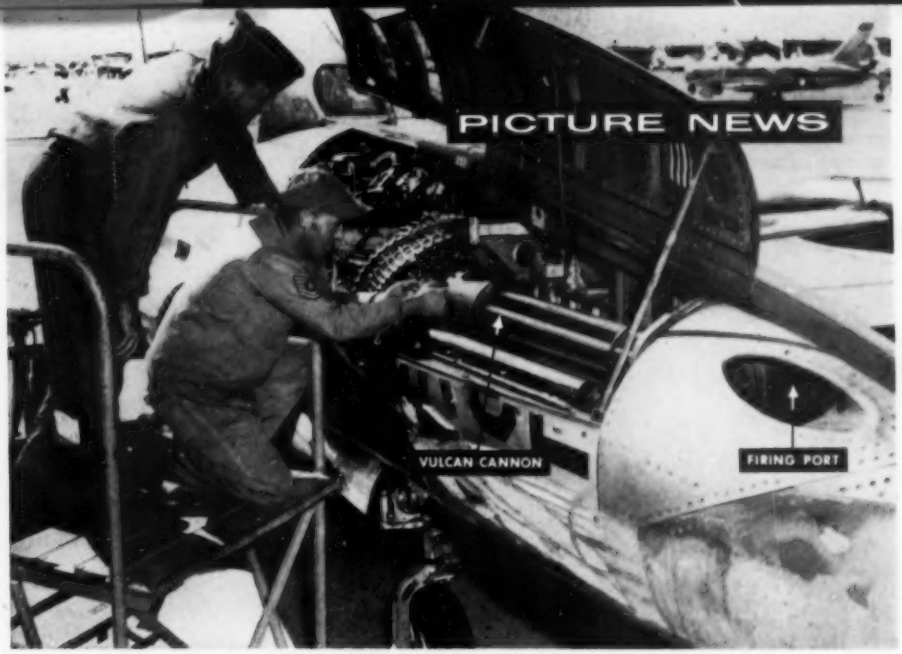


Peewee "Memory" Knows a Lot

This little electronic computer stores 2,560 bits of information. Shoebox size, RCA says it will hold a million. And it disgorges knowledge in a microsecond.

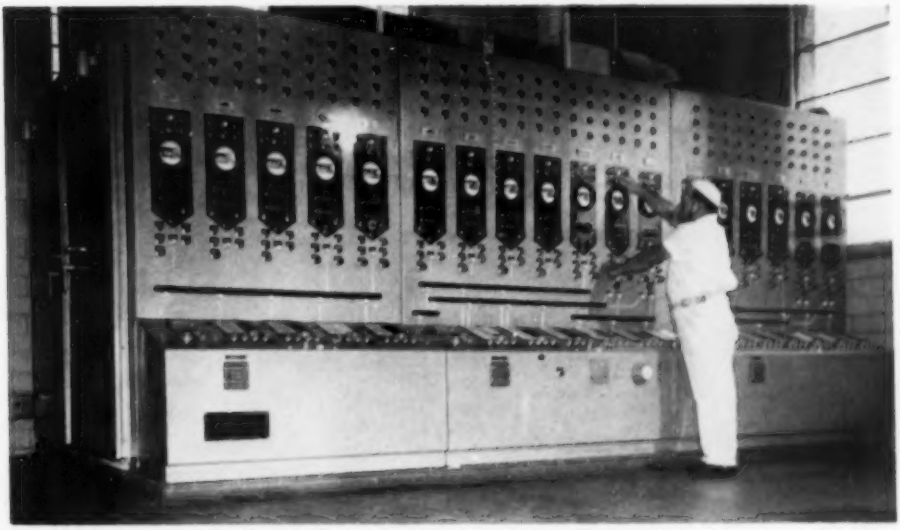
Spare Gas Is Held by Spare

A can for an emergency supply of gasoline is being made in Czechoslovakia to fit inside the spare tire. It takes less room in the trunk, holds 1½ gallons.



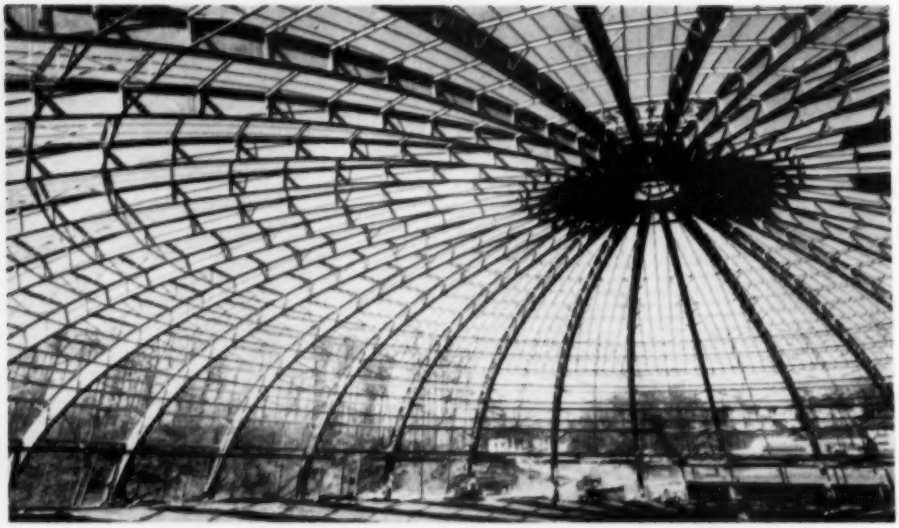
"Gatling" Gun Makes Jet the World's Fastest-Firing

THE Vulcan, a 20-mm. aircraft cannon with six rotating barrels, is getting its baptism of fire in the Air Force's F-94 Starfire jet interceptor. Designed for attack and defense at supersonic speeds, the new, electrically operated machine gun is based on the famous Gatling Gun that first saw service in the Civil War (PS, Nov. '56).



Push-Button "Brain" Turns Recipes into Cookies

OUTSIZE, maybe, for your own kitchen, but National Biscuit Co. finds this electronic control console a fast mixer in its Philadelphia bakery. The "brain" measures out sugar, flour and what-not for 16 mixing machines, distributing 62 tons accurately in an eight-hour day.



Big Steel Dome Tops Underground Basketball Arena

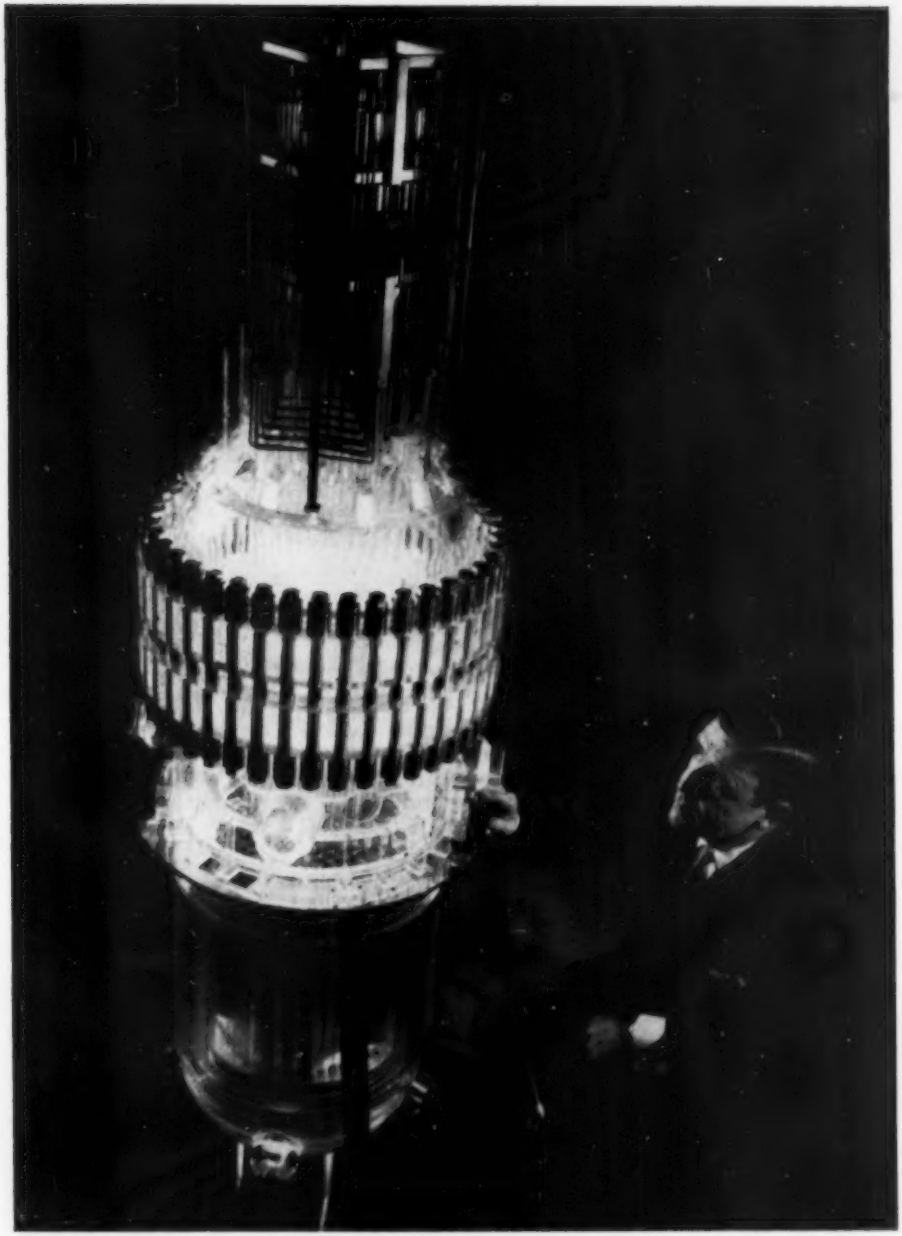
FRAMEWORK for the roof of the new Alexander Memorial basketball arena at Georgia Tech covers a huge bowl-shaped sports center that's entirely underground except for the 270-foot-diameter dome. It's built on a framework of 32 girders. The arena will seat exactly 6,999.

Wheels Roll in Test "Tank"

ON THIS test table, University of Michigan engineers test man's oldest invention —the wheel. Their aim: to make Army vehicles roll more efficiently. After heavy going in this sand, the towed model wheel will plow through clay, squish through mud and rumble over rock.

Clamshell Car Embraces Cargo

COILS of rolled sheet steel ride the rails in this car protected by cylinder halves that open and close by means of a crank-and-gear mechanism. The Evans Products Co., Plymouth, Mich., maker of the clamshell car, says that it prevents shifting and weathering of its special cargo.



Atomic Furnace for Light Plant Is Previewed in Plastic

A NUCLEAR reactor just like this—but 33 feet high and nine feet in diameter—will be the heart of the first atomic power plant to light up American homes. It will be built at Shippingport, Penn., by Westinghouse. The model, largely plastic to let you peek at the innards, gives a good view of the uranium core in the base.

Twin-Arch Steel Bridge Wins Top Award for Design

JUDGED the most beautiful big bridge of the year, this steel span over the Missouri River at Leavenworth, Kan., will display a plaque to mark the honor. A jury of architects, engineers and art experts chose it for the gracefulness of its simple repetitive arches. A bridge at Kansas City, also spanning the Missouri River, won the preceding award.

Rear-View TV Gives Hindsight Without Use of Mirror

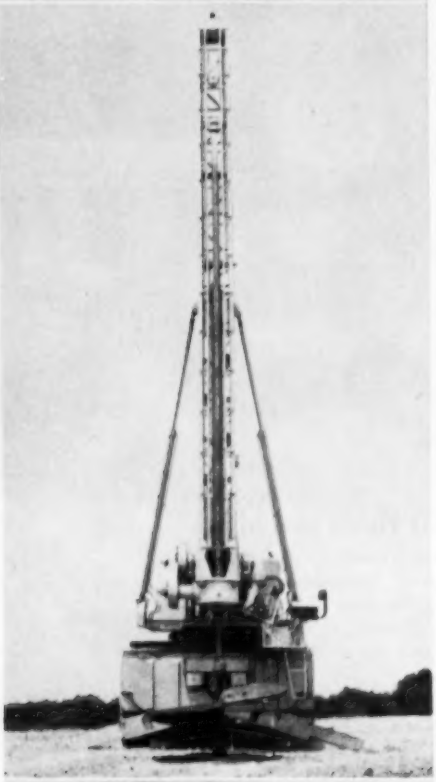
TO MAKE British eyes pop, Buick showed its Centurion "dream car" at the Earls Court show. A feature was the dashboard TV screen, which gives the driver a view of traffic behind as seen by a camera in the rear. Buick says that the setup provides a clear picture, even at night, but it isn't predicting when the device will replace the $3 mirror.

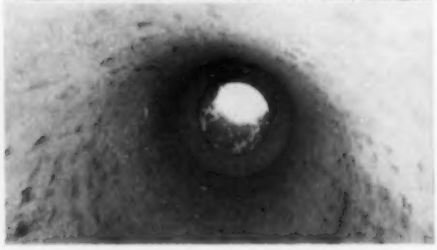
Mechanical Grasshopper Does Job of Three Machines

ARMS flailing in all directions, this British tractor can dig a ditch, excavate for a house, or level off rough ground, dumping earth into a truck. The swiveling digger bucket at the rear reaches 10 feet down and eight feet up; the dozer-loader in front lifts 13 feet. Both attachments operate hydraulically and are designed for use on a British Fordson.

Row of Pipes Carries Traffic Over Flash-Flood Area

WHEN an old wooden bridge had to be replaced, Pennsylvania highway authorities laid sections of steel pipe across this flash-flood area near Mill Village. The pipe arches were assembled from preformed sections, and the bridge cost less than rebuilding the old one would have. A blacktop roadway takes two lanes of traffic.





Drill Stands Tall to Dig Deep

A PORTABLE earth auger weighing 25 tons and stretching 90 feet up in drilling position is being tested by Army engineers. It will speed-drill a hole (bottom photo) up to nine feet in diameter and 75 feet deep. For hauling, the rig lies down on a standard military trailer.

Prop Power Takes Auto Aloft . . .

THE "Versatile I" can be converted from air to road travel in 15 seconds. That is the claim of its inventor, Dr. Lewis A. Jackson of Central State College, Wilberforce, Ohio. He simply removes a small locking pin, pivots the wing, and revs up. A bumper guard keeps pedestrians and

Speed Mask to Slow New Trucks

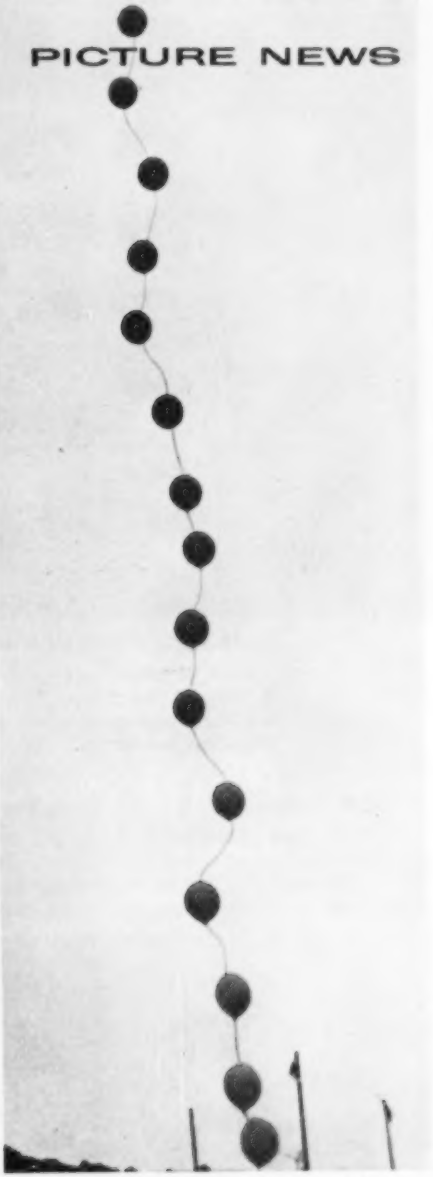
A CARDBOARD cutout that masks the speedometer section above 40 m.p.h. is supplied by the General Motors Truck Corp. with new trucks. The idea is that a driver, not being able to see the higher speed ranges, will keep within the 40-mile limit for the first 500 miles.

. . . or Rolls It at 50 M.P.H.

the back ends of other cars at a safe distance from the spinning propeller. Being air driven, not depending on traction for ground travel, the vehicle is not bothered by mud, snow or ice. Powered by an 85-hp. Continental engine, it can fly at 100 m.p.h. and land at 55.

Pets Get Own Rail "Roomettes"

THE comfort of animal as well as human passengers is considered by the German Federal Railroad. Its coaches have special compartments for pets. Doors that open on the outside of the cars enable the animals' masters to feed, water and exercise their pets at station stops.



Balloon Train Reads Weather

A TRAIN of 15 instrument-carrying balloons was sent up recently in Switzerland to obtain comparison weather data. As the string rose to an altitude of about 13 miles, each of the balloons took separate readings and radioed the information back to ground stations.

Outboard Powers Hot-Water-Tank Raft for Pier Crew

BASE of operations for a two-man crew that works on the maintenance of piers at the Seattle Army Terminal is a crude but utilitarian craft. A 10-hp. outboard motor put-puts the Slo Mo, which is made of four 60-gallon hot-water tanks covered with wooden planks.

B-52 Bombardier Takes Over for Bomb Run on Target

IN THIS first operational photo ever released of the master panel of Sperry's K-System bombing device, the bombardier of an eight-jet Boeing Stratofortress grips the control handle as he peers into the radarscope. He gets full control of the A-bomber when it nears its target.

Boy Builds Do-It-Yourself Rocket in Basement

EAGLE SCOUT James Blackmon of Charlotte, N. C., startled Army rocket experts when he explained that the nose cone of his six-foot rocket was a five-dollar metal lampshade. Although 17-year-old Jimmy's plan to fire the missile on a farm was balked by CAA rules, the project did win him the American Rocket Society $1,000 science-youth award.

Wanna Wash a Duck? A Scientist Tells You How and Why

THESE mallards, a drake and a duck, work for science and are helping Harold E. Schlichting, a biology instructor at Michigan State University, to obtain his Ph.D. To find out to what extent these wild birds transport microscopic animal and plant life from one body of water to another, Mr. Schlichting first washes the feet of his ducks in a detergent

Concrete "Dogbones" Keep Beach from Washing Away

SOME of Florida's plush beaches are being safeguarded by an unusual wall. Zigzagging concrete bars, called "dogbones" by their inventor, William Budd, not only keep the sand from washing away, but actually build up the beach by slowing down the rush of ocean water. As sand accumulates, more dogbones, locked in by concrete poles, are added.

and then hangs them out to dry at the Kellogg Bird Sanctuary, near Kalamazoo. Next he places his clean-footed birds in a large nearby lake. After they have been in the water for 15 minutes, he takes them out and puts their feet into plastic booties filled with sterile water. In this water he grows cultures that can be studied to identify any organisms that have been picked up by the mallards.

Reconnaissance Copter Can Double Ship's Radar Range

ANY Navy vessel large enough to have a landing platform could have early-warning radar coverage by sending up this new Sikorsky helicopter. It carries a high-power GE airborne search radar that is able to detect a low-flying enemy plane more than twice as far away as a shipboard radar. A mushroom-shaped radome in the nose houses the antenna.

His Cartoons

Master Sergeant Steve Hotch keeps Air

Fliers read, and heed, safety lessons when they are presented in this eye-catching manner.

Save Pilots' Lives

Force flyboys flying by luring them into taking advice from a paper hero, Major Rex Riley.

By Jerry Hulse

ASK any flyboy to name the most familiar face in the entire U. S. Air Force and probably he will say, "Rex Riley's."

Technically, the owner of the face (above, right) is Maj. Rex Riley, a handsome man in his thirties with crewcut blond hair, dimpled chin, serious blue eyes and a strong, square jaw.

He's probably the Air Force's favorite boy in blue, too, for he tells pilots how to keep out of accidents.

Riley is pure fiction, a cartoon-strip hero devoted to helping save the lives of our Air Force fliers. He is as familiar to the men of the Air Force as the girls they leave behind. The once-a-month strip in which he stars, "Major Rex Riley, Aircraft Accident Investigator," comparable in size to most newspaper comics, hangs in Air Force ready rooms from Kiska to Korea and from Boston to Berlin.

Cartoonist sticks close to subject

But there are some jet and bomber jockeys who refuse to believe that Rex Riley exists only on paper. So convinced are they that he lives, breathes and wanders with them up there, that they send him planeloads of fan mail.

Should they receive a reply, however, the penman would be, not the dashing Rex Riley, but his benign papa, Air Force Master Sergeant Steve Hotch.

Pilots and crewmen are quick to spot and jeer at technical errors, even in cartoons of the planes they fly and service. So Sgt. Hotch, sketch pad in hand, haunts the flight line at Norton Air Force Base (Calif.), observing details and absorbing shoptalk

Steve Hotch has been sketching the Rex Riley cartoon strip since shortly after it was created, by Capt. Richard Grant, nearly 10 years ago. It wouldn't be farfetched to say that the safety lessons projected by the 38-year-old Hotch through his cartoon hero have resulted in the saving of literally hundreds of airmen's lives. Not to mention the millions of dollars' worth of planes that have avoided the scrap heap.

Steve is stationed at Norton AFB, San Bernardino, Calif., in the headquarters of Brig. Gen. Joseph D. Caldara, the Air Force's director of flight safety.

He gets $386 a month for this strip that reaches around the world to all Air Force bases. Nothing extra, mind you, for his unusual artistic abilities; the $386 represents only

his regular duty pay, plus allowances for living off the base.

But Hotch is no mercenary guy. He's happy and content in the "most satisfying" job he's ever had. It's a job that entails more than ink and scratch pad. The search for an accident subject for his monthly Rex Riley cartoon strip is a trying task.

Accidents follow a pattern or trend, in many instances, Air Force safety experts know. Therefore, the plan is to recognize the trend before it grows out of control, then get Rex Riley busy sounding the alarm.

Safety lesson: be weather-wise

But first, Steve and his immediate superior, Maj. Perry J. Dahl, must sift through daily accident reports channeled into Norton AFB from every other U. S. base in the world to detect the beginning of a new trend. Perhaps they learn that half a dozen F-80s have crashed recently during emergency landings at scattered bases. Thus, a trend has been established that may take more lives.

The "Rex Riley" strip from which these dramatic panels were taken depicted a needless disaster that overtook a pilot who stubbornly flew by visual flight rules. With dubious weather ahead, he should have switched over to instrument flight

Immediately, the experts are contacted—pilots themselves, manufacturers and others who may be concerned—for advice regarding emergency landing procedure in such aircraft. The crash reports themselves reveal probable pilot errors, as determined by the investigators.

Back to the drawing board goes Steve now. With the information he has gathered, he begins sketching, telling through Rex Riley the whys of the crashes and how they could have been avoided.

Once the strip is finished, it is viewed by scores of experts to determine its accuracy.

If discrepancies are brought to Steve's attention, he makes the necessary changes. Finally, it is ready for distribution. It is doubtful, indeed, if any other cartoon strip is more quickly circulated. Bombers, transports and even jet fighters roar off to deliver it within hours to every corner of the free world.

Proof that advice given in the cartoon strip is responsible for saving many lives is contained in the letters that come into Steve Hotch's office.

Recently, a strip began with Rex Riley saying, "I believe this following information on ditching will be helpful to pilots flying the F-86 when bailout is impossible."

Riley goes on to describe the procedure, with each instruction illustrated—the position of flaps and dive brakes, release of tip tanks, jettisoning of the cockpit canopy and,

last, settling the plane onto water. After the strip was published, Steve Hotch received the following letter from an F-86 pilot:

"I was thundering along when flameout occurred," he wrote. "At first I was scared stiff. Then I remembered the advice of Rex Riley and followed it. As a result I ditched in the ocean without a hitch. In my book, Rex Riley should be a general!"

One of a pilot's greatest nightmares—no matter how long he has been flying—is that one day he will make the cardinal error: a wheels-up landing.

What causes a pilot to forget such an elementary procedure? Too much partying the night before? Worry over a fight he had with his wife? The reasons and excuses vary. But Rex Riley knows that gear-up approaches continue as one of the prime "human error" mistakes in airplane accidents.

Therefore, one of the Riley strips was devoted to a wheels-up landing in a T-33. It served as a reminder for a jet pilot in Japan, who wrote, "There I was on final approach, when for some reason—don't ask me why—I realized I had failed to extend the landing gear. Another 30 seconds and I'd have been all over that field. But those 30 seconds gave me time to recall the Riley story. I gunned her, climbed up, dropped the gear and came in safely."

Investigating a real-life drama, not long ago, Air Force experts were at a loss to determine why an F-84, flying formation with other jets at 17,000 feet, suddenly dropped in a fatal, howling spin. There wasn't a particle of evidence to focus the cause on mechanical failure. Finally, the investigators sought the advice of an Air Force doctor, who learned that the pilot had been a heavy smoker. It was the doctor's conjecture that the pilot had removed his oxygen mask and lit a cigarette. This violation of a fundamental safety rule for jet fighter pilots, and its calamitous result, was the subject of the poignant "Rex Riley" strip reproduced on page 156.

One pilot who read that strip "quit smoking completely."

Maj. Riley's whistle-provoking secretary, a significant asset of the cartoon strip, seldom speaks—just sits there and looks sexy. Steve describes her as "merely window dressing, just something to attract attention."

Visiting fliers calling at Steve's office unfailingly urge, "Come on, Sarge, introduce us to Rex Riley's secretary!"

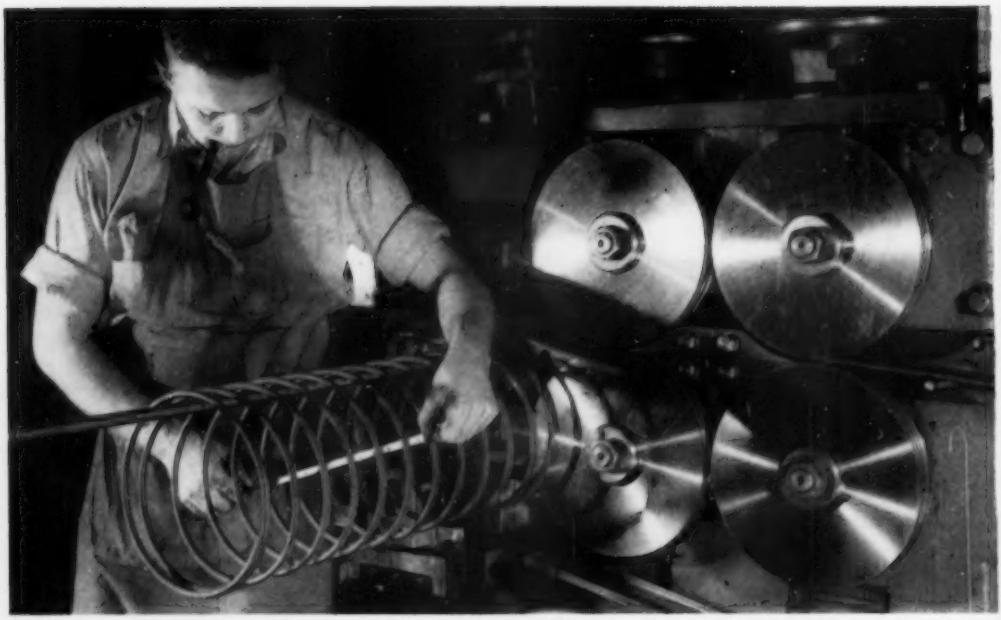
"The guys demand an introduction and sometimes get real sore when I try to explain to them that there's no such gal," Steve says.

The little cartoonist—he's only five feet, six inches tall—

[*Continued on page 244*]

Safety lesson: don't be rash

These vivid drawings of a T-33 (jet training plane) in perilous, unauthorized maneuvers pointed up Rex Riley's warning to follow definite emergency procedures when a tip tank fails to feed properly. In this case, happily, the error wasn't fatal



GIANT COILING MACHINES make huge helical springs. Stock is forced between metal fingers that coil it to the desired diameter. When the spring is long enough, a shear snips it off.

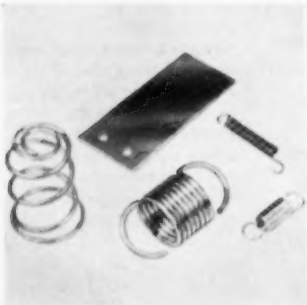
Things You Never

By George H. Waltz Jr.

ALTHOUGH you may not think much about it in these days of sleek cars that all but drive themselves, atomic power, and fast-flying jet aircraft, your everyday life still depends on a simple, centuries-old gadget—the common spring.

Without springs, there would be no automobiles, no airplanes, no modern streamlined kitchens with their automatic washers, dryers, ironers, timers, toasters and coffee makers. In fact, there

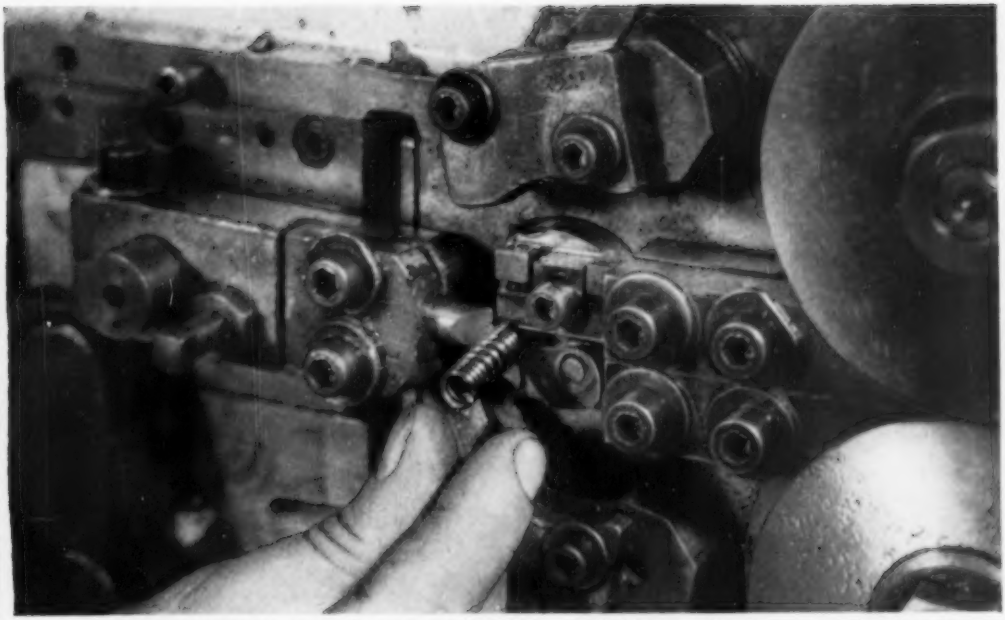
All these springs—and more—may be in your own kitchen .....



DISH WASHER

STOVE

CLOTHES WASHER AND DRYER

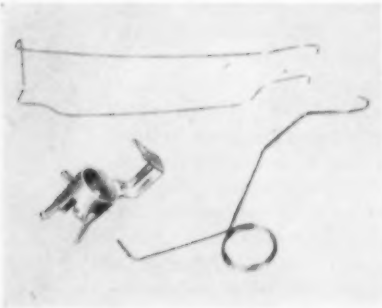


SMALLER SPRINGS are made on a machine like this. A coiling machine's operations are controlled by a series of cams. By changing the cam setup, a wide variety of springs can be made.

Knew About Springs

would be no electricity and no comfortable spring beds, no safety pins, no typewriters, no printing presses, no political campaign buttons, few musical instruments, no television and no hi-fi!

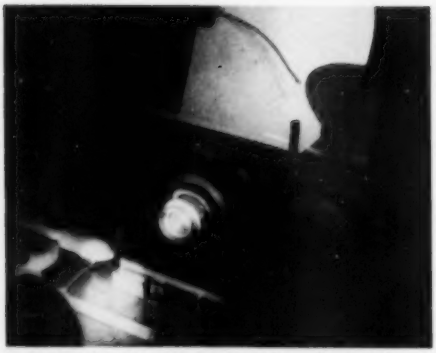
Springs can be designed to do just about any job where energy—in the form of a push, pull or twist—must be stored and released. In Bristol, Conn., at the Wallace Barnes Division plant of the Associated Spring Corp., where the accompanying photos were made, over 50,000 different items a year are turned out. Some, weighing less than 1/5,000th



TOASTER

MIXER

REFRIGERATOR



SHADOWGRAPH TESTER is used to check delicate flat springs. Magnified image of tiny spring shows whether or not the spring meets the precise tolerances specified by the customer.

ROLLS OF FLAT SPRING STOCK are stacked on the base of the big annealing furnace in which they will get a 1,300°F., 22-hour heat treatment to remove any stresses or strains in the metal.

STOCK FROM LARGE REELS of spring wire passes progressively through high-heat furnace, quenching unit, low-heat tempering furnace. Hardened, it's then rolled back onto reels.

of an ounce, give a featherweight nudge. Others weigh many pounds, and are capable of exerting muscular pushes or pulls. The Barnes company has been making springs for 100 years. In the early days, most of its business consisted of making metal hoops for hoop skirts.

Springs fall into two general classifications—wire and flat. Most common of the wire springs are coil type, giving either a push (compression spring), a pull (tension spring) or a twist (torsion spring).

Most coil springs are made by an automatic coiling machine or equally automatic winding machine. In the coiler, spring stock, which can be formed cold in diameters up to ½ inch, is forced into a spiral by strong metal fingers. In a winding machine, the stock is actually wound around a mandrel of the desired diameter.

Conventional flat springs, like those used for catches, latches, clamps or your fountain-pen clip maybe, are stamped out in high-speed blanking presses. Some of these can produce as many as 30,000 springs an hour, performing multiple operations to produce desired shapes and designs. Flat springs with complex bends are generally made in a "multiple slide" machine. Here, a number of forming tools (or "slides") converge to shape the spring-metal stock.

Hand-operated coiling machines form two important types of springs: the hairspring and the power spring. The hairspring forms an important part in timing devices, speedometers, electric meters and steam gauges. The power spring, a grandson of the clock mainspring, finds its way into parking meters, movie cameras and the like.

Unlike screws and bolts, there isn't a really standard spring. It can vary from tiny spring washer to giant helical—for a railroad car. Even if two look alike, their qualities may be far different. So the manufacturer who has just run off several million duplicates for one order may look at his next order and find that it calls for a special-purpose singleton for an experimental weapon. END

Will Bomb Dust Endanger Your Health?

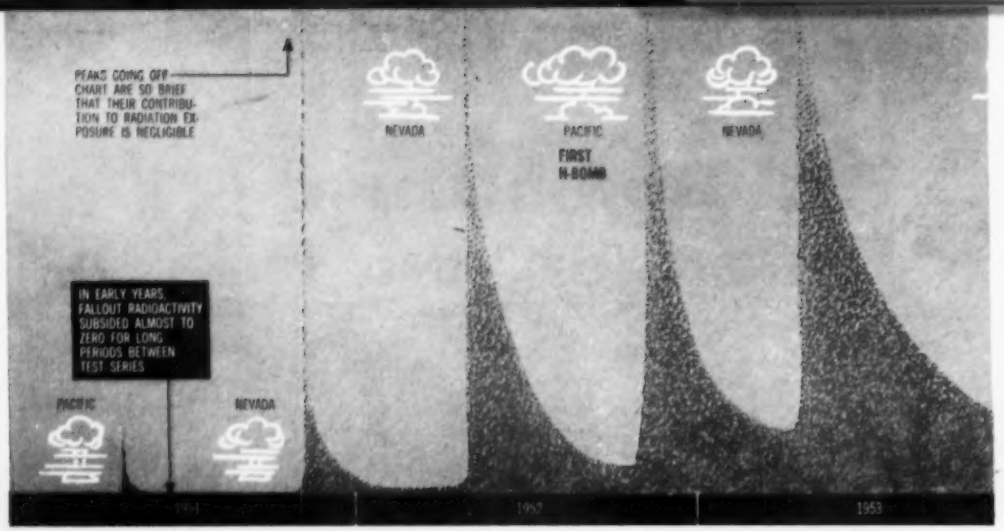
By Alden P. Armagnac

New evidence on nuclear fallout stresses possible hazard to people now living. The danger: bone cancer from strontium 90.

THE wraps are off one of the greatest of scientific studies under way today—worldwide in scope, of utmost concern to everyone on earth. Known as Project Sunshine and only recently made public by the U.S. Atomic Energy Commission, its aim is to gauge the hazard to health of the radioactive strontium 90 that nuclear-bomb tests are depositing in our soil, in our food, and finally in us.

For recent evidence puts the finger on strontium 90, a potential cause of bone cancer and of leukemia, or blood cancer, as the principal hazard of the radioactive fallout that A-bombs and H-bombs are

STRONTIUM 90 LOOKS LIKE THIS. Called fallout's most dangerous ingredient, strontium 90 deposited in soil is in form of radioactive strontium carbonate—identical in appearance and in chemical behavior with this white powder, which is ordinary nonradioactive strontium carbonate. The kind that fallout leaves in soil is scattered far too thinly for any trace to be visible.



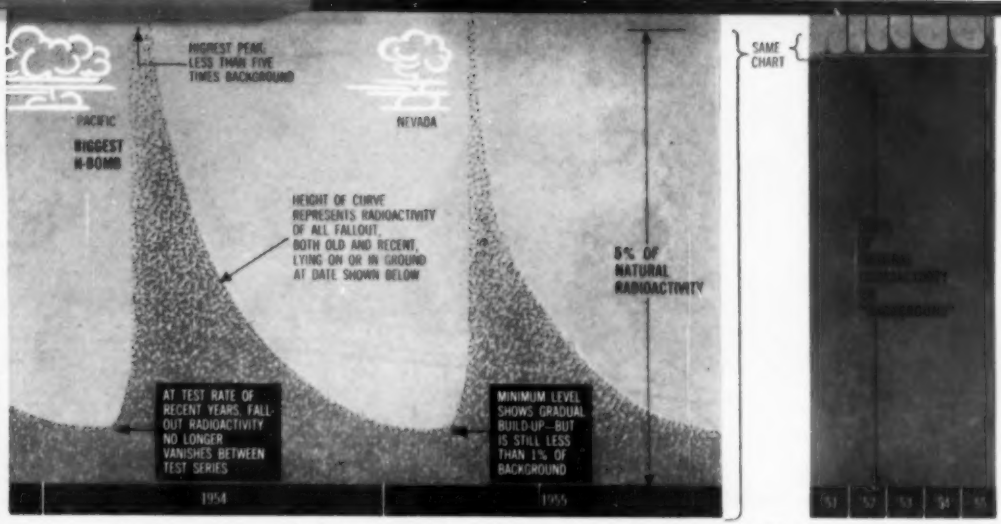
FALLOUT OVER NEW YORK: This chart, first of its kind in a popular publication, shows fluctuations and slow buildup of cumulative radioactivity from all past "mixed" fallout in New York City. Amount represents balance between dying out of radioactivity, and new additions. At bomb tests' rate in period shown, minimum level has been gradually rising—but still is in-

scattering all over the earth. That conclusion marks a radical reversal of thinking in the past.

Until lately, the scientists most concerned over fallout have been the geneticists. Their widely publicized fear has been that the body-penetrating gamma rays of fallout would cause harmful changes in individuals' genes, the seeds of heredity—and lead to an abnormally high number of cripples and other defectives in generations to come. But a celebrated study completed last year by 150 leading scientists, for the National Academy of Sciences, disposed of that bugaboo for the present at least. It found your exposure to this kind of fallout radioactivity to be insignificant, compared with the ever-present "background" of natural radioactivity from

"STRONTIUM POT" of stainless steel is set out on roof of AEC's New York building to measure amount of descending strontium 90. Pot collects a week's dust and rain, fallout included.

CONTENTS OF POT are rinsed and scrubbed into beaker, to be evaporated down to a residue of brownish-black mud, from which strontium is chemically separated and its amount determined.



significant, compared with natural radioactivity. (See full-scale comparison at extreme right.) Chart is based on official AEC measurements and estimates for all U.S. A-bomb and H-bomb tests' fallout from 1951 to 1955, the last year with complete figures available. Foreign tests, not included, would have altered the figures charted here by no more than 10 percent.

sources like cosmic rays, and radium and thorium in the earth.

Strontium 90, in contrast, has nothing to do with genetics or heredity. Instead of the penetrating gamma rays that come from some ingredients of fallout, it emits only short-range beta rays. So it's harmless while it lies in the ground—and until plants absorb it, cattle eat it, and it enters your food. Then, built into your bones along with the calcium that it chemically resembles, it bombards them with internal radiation. Its rays, which cannot reach the reproductive organs and genes, affect only the individual himself.

Already some children have accumulated a measurable amount of strontium 90 in their bodies, presumably from the milk of cows that grazed on contaminated pasturage, says the National Academy of Sciences. While the quantity detected in humans has been harmless so far, it's gradually rising—and will bear watching. That warning, alerting official quarters some time ago, quietly mobilized an army of researchers and sped them to outposts near and far.

Aerial observers have been flying planes to 45,000-foot altitude, and sending unmanned balloons to 100,000 feet, to learn how much strontium 90 is still floating aloft. What's come down has been sampled in alfalfa, canned fish, and human bones. Facets of the far-flung project include a Pasture Program, a Turnip-Top Experiment, a Milk Program. Newly promoted to the rank of scientific apparatus are 12-gallon Army cookpots of stainless steel; found the most efficient collectors of strontium 90 in fallout, they've been set out on rooftops at the AEC's New York City building and elsewhere.

First returns now are in. Even if bomb tests in all countries were stopped today, they show, strontium 90 would continue to accumulate in the soil, and reach a maximum about 10 years from now. For only a fourth of the strontium 90 from past tests has settled to earth so far; the rest, now floating high in the stratosphere, has still to come down.

Just from bomb tests already made and within perhaps a decade, it's possible that the strontium 90 in people's bones may reach a maximum figure of 25 percent of the permissible limit, predicts Merril Eisenbud, manager of the AEC's New York Operations Office. It's also possible, he adds, that that estimate may be 10 times too high; for his calculation involved many still-uncertain factors, and he purposely used the most pessimistic

How fallout gets from bombs to you . . .

1 BOMBS YIELD THREE KINDS of fallout. Concentrated deposit falls near bomb site within a few hours. Windborne particles, circling

figures. Then, too, the "permissible limit" itself (1/10,000,000 of a curie of radioactive strontium in the human body, the recommended limit for the general public) is a highly arbitrary one that may err far on the safe side.

Despite those qualifications, it's now clear that we're much nearer the advisable limit for strontium 90 than for the rest of fallout's radioactivity.

Our margin of safety still is wide. But a marked acceleration in the current rate of bomb testing could narrow it to a less comfortable one, the Eisenbud figures suggest.

"HOT" FISH, caught in Bikini lagoon after A-blast, had radioactive meal pictured by own rays in lower view. Whether fallout might thus turn up in seafood is now under study.

In case of an all-out nuclear war, increasing fallout a thousand-fold or more, it's even possible that the safety margin could vanish altogether. Then there might be real danger of bone cancer from strontium 90—especially among those who were babies at the time, and whose growing bodies would be exposed to the bulk of a war's fallout a decade or so later. To meet the prolonged post-war emergency that conceivably could arise, large-scale decontamination of food might be necessary.

To be forehanded, the AEC has already been doing some research along that line. A recent and promising experiment, upon milk artificially contaminated with strontium 90, showed that the milk could be completely purified by an "ion-exchange" treatment with a material called Dowex-50 W resin. The method also removes the milk's calcium, which would need to be replaced afterward by adding a suitable calcium salt to the decontaminated milk. (Incidentally, one tall tale of the last election campaign had it that this experiment was being kept "secret" from the public by the AEC; actually you could read the full report of it in 49 libraries or buy your own copy for 15 cents, as this magazine did, from the U. S. Department of Commerce.)

Scientists of Project Sunshine, which

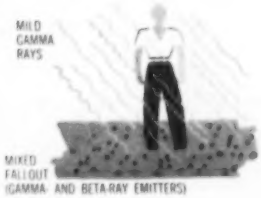
earth in troposphere, descend in weeks. Particles shot into stratosphere, by H-bombs, float there for years before coming down.

has now grown to an international project with many countries participating, expect to fix more precisely the strontium 90 safety limit and the nearness of our approach toward it. Then, what to do about it will be up to the world's nations to decide.

Meanwhile we're taking steps to limit the strontium 90 loosed upon the world by our own tests. Besides moderating the scale of H-bomb testing since our big bangs of 1954, the AEC last year announced successful trial of a "clean" H-bomb—in its own words, "a megaton-range weapon with an inherently smaller amount of fallout for a given energy release." But if the Russians and others prefer to stick to "dirty" bombs, that's beyond our control.

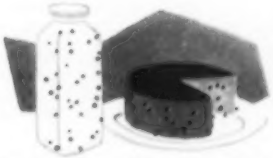
Just what is this newly important strontium 90? Strontium has long appeared on the list of chemical elements. It takes its name, as does the mineral strontianite that yields it, from the site of the mineral's discovery: Strontian, Scotland. It's a silver-white metal, but you're more apt to see it in the form of white compounds like strontium carbonate and strontium nitrate; the latter imparts a red color to fireworks and signal flares. Ordinary strontium metal and its compounds are neither radioactive, nor especially toxic. They contain several natural "isotopes" or varieties of strontium, mostly one called strontium 88.

[Continued on page 256]

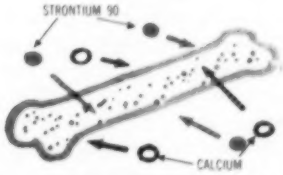


2 GAMMA RAYS from fallout on ground irradiate you mildly. Short-range beta rays of long-lived strontium 90 can't yet reach you.

3 PLANTS ABSORB STRONTIUM 90 in drawing up minerals from soil. Cattle that graze upon the plants pick up the strontium, in turn.



4 MILK AND CHEESE, calcium-rich, will also contain the calcium-like strontium 90 eaten by cows, and pass it along to your table.



5 MISTAKING STRONTIUM 90 for needed calcium, human bones take up both, and so become target of strontium's radioactivity.

Now You Can Trade In

By John L. Springer

SAY you're a typical young homeowner. Your family is pushing out the walls of your small house. You'd like a bigger place, but you can't make the down payment until you get your savings out of your present house. And if you sell the old house first, unless you find another suitable house right away, you may be stuck for a place to live.

It's been a rough problem—up to now. But today there's a way of selling your old house and buying a replacement that's as easy as swapping autos. In fact, it works the same way—because home builders and real-estate brokers by the hundreds now will take your old house in trade when you buy another from them.

This new idea of "house trade-ins" is growing by leaps and bounds all over the country for two simple reasons:

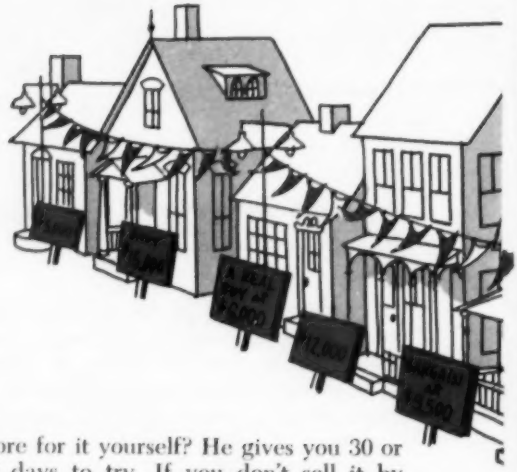
- The big postwar demand for houses has let up. Builders have to look harder for customers, and give them extra incentives to buy.
- Most people now buying new houses already own homes. They're usually looking for either a bigger or better place to live, or both. But first they must unload the house they're in.

Put 1 and 2 together, and the answer adds up to trade-ins.

The deal is often quite simple—like the one you'd make at your car dealer's. You find a new house you like, learn how much the builder will allow on your existing house. If the allowance is satisfactory, you sign the contract and move from house No. 1 to house No. 2 without a hitch. The builder sells your old house at the best price he can get.

There are also many other ways of doing it. For example:

A builder may offer a flat price for your old house. Think you could get more for it yourself? He gives you 30 or 60 days to try. If you don't sell it by then, you take his price.



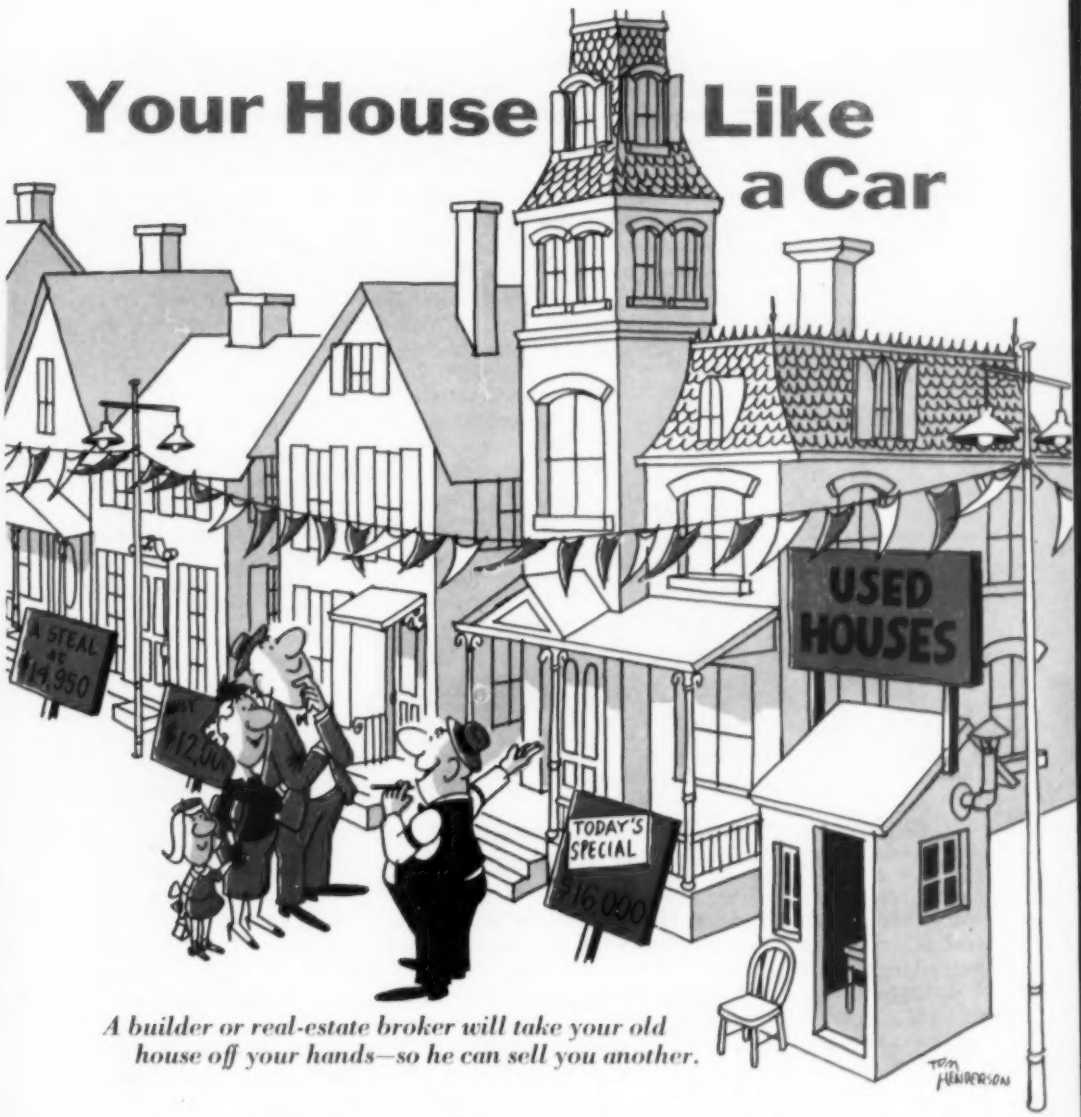
Or he may try to sell your house at your price, even if it seems high. If he finds a buyer within 30 days, you get the full amount. But after that, you're obliged to sell it to him at his price. Of course you would have to be satisfied in advance that the builder's price was a reasonable one.

Another possibility: The builder thinks you are asking a reasonable price and his salesmen work on it for 60 days. If they can't sell your house at your price, he returns your deposit and tears up your contract to buy a new house.

Builders all over the country now take trade-ins and, according to trend-watchers in the building field, the number is growing every day. "Trade-ins are here to stay," they tell you, "and before long, a trade-in setup will be as necessary to the builder as a used-car department is to an auto dealer."

Big developers like the Levitts of Levittown, who put up thousands of houses every year and have no trouble selling them, can't be bothered—yet. Right now, you are most likely to make a trade-in deal with a small builder.

Your House Like a Car



A builder or real-estate broker will take your old house off your hands—so he can sell you another.

How do you go about trading in your old house?

First decide on the house you want. Then ask the builder if he takes trades—and tell him you must first sell your present house to get the down payment for his. He may outline one of the proposals cited above. At the very least, the average builder in today's buyers' market will probably suggest a broker to help you dispose of your house quickly so you can buy his.

What kind of homeowners are trading in? Just about all types:

A young couple in an eastern state had a Cape Cod cottage with two bedrooms. They wanted two more bedrooms and another bath. They could have expanded their attic and financed the work through an FHA loan, which they'd have had to pay back in three years. Instead, they decided to buy a new house with four bedrooms under a long-term mortgage with lower monthly payments. They

went to Jerome Spies, head of a realty firm that has handled hundreds of trade-ins since early in 1956. Spies found the house they wanted and gave them a flat price for their old house, which he sold after they moved.

In Fort Wayne, Ind., a widower with his own house met and wooed a widow with *her* own house. They were married. Builder John Worthman, one of the country's most experienced trade-in experts, took over the two houses—one worth $11,500 and the other $5,000—and sold the newlyweds a "honeymoon house" for $21,376.

When the walls begin to bulge, a growing family starts looking for a bigger house.

An elderly couple in Elizabeth, N. J., had a huge 12-room house—fine for them when their youngsters were growing up but too big now that the children were married. They traded in and wound up with a small new ranch house, plus $15,000 in cash.

Sometimes a developer winds up selling four or five old houses to dispose of one new model. A builder in Wichita, Kan., sold a new ranch house for $14,750. He took a large old house worth $17,250 in trade. He sold this house to a big family, allowing them $14,000 on their house. He sold house No. 3 to another growing family—and took their $9,000 cottage in trade. Finally, he sold the fourth house for cash—months after the first transaction.

You can pocket extra cash. Just as you trade in a fully owned car for a new model you buy on time, so you can buy a more expensive house than your present one and wind up with folding money. John H. Seiter, vice president of the Washington Heights Federal Savings and Loan Association in New York, which underwrites many mortgages for new houses in the metropolitan area, explained how this could work.

You swap a low mortgage for a high one. If you've owned a house worth $20,000 for a dozen years, chances are that your mortgage is now less than $6,000, leaving you $14,000 to the good. You buy a new $25,000 house for about $7,000 cash and you have $7,000 left over. Of course, you now owe $18,000 on the new home.

If you move to another city and buy a new house, it's even barely possible that you can trade in your old home miles away. Dick Hughes, builder of Pampa, Tex., had a chance to sell new houses to employees of a petroleum company transferred from Wichita Falls and Dallas. He took their trade-ins, then hired brokers in those cities to sell the houses.

If you're reasonably handy with tools, you can "work" your way into a better house. Richard Hansen, former president of the Wisconsin Home Builders' Association, sold a house for $9,200. A few years later the buyer wanted a new model worth $13,200. His mortgage left him only $2,700 equity in the older house and he needed a down payment of $5,500 for the new one. He went up to his unused attic and finished it with two bedrooms and a bath—which his

family did not need—thus boosting the value to $12,000. He got enough out of the old house to swing the new one.

Even if your house could stand plenty of improvements, don't hesitate to offer it in trade. Some builders prefer that kind of house. They have special crews to handle nothing but modernizing work. Often they'll spruce up your old house and make a good profit—plus the profit on the house they sell you.

How much does it cost you to trade in your house? Builders and brokers say that disposing of your old house this way costs no more in cold cash than if you sold it through a broker: about five percent of the sales price. A builder or broker who thinks he can resell your house for $10,000 may offer $9,500. For that $500 difference—his five percent profit—you get the security of knowing that the sale is clinched. You're free to plan to move into your new home.

Biggest problem in trading, most builders agree, is the inflated values homeowners put on their houses. The typical owner may get 10 years' use from a house, yet never considers depreciation. He wants as much as, or more than, he paid.

"More trades are killed by the inflated prices owners want than for all other reasons combined," a broker told me. One homeowner bought a new ranch house in 1951 for $11,000. It had a new paint job inside and out, new kitchen equipment and new plumbing. Although his three youngsters have banged the house up plenty, he could get $13,000 for it—a neat $2,000 profit plus five years of free use. But he wants $15,000.

Setting a fair price on a house is a troublesome problem. With cars, it's easy. Prevailing wholesale and retail prices for your make and model are published every month. You can always get a good idea of its current value, give or take a few dollars depending on its condition. With houses, however, dozens of individual factors—the lot, street, condition of the paint job, plumbing, etc.—are involved.

Many trade-in operators hire an appraiser to set a market value. Appraisers must know what they're doing, because the amount a bank will lend depends upon their judgment. If you match an appraiser's estimates—the value of the house you're thinking of buying vs. the value of the house you want to sell—you'll know lots better whether you're getting a fair shake on the deal. END

DO'S and DON'TS when you're ready to trade

YOU will want to put your house in the best possible light to a builder or broker—just as if you were selling to a private buyer. Here's how:

Do correct major flaws that make the house seem unsafe (big cracks in the foundation walls, wobbly stairs, etc.).

Do make minor repairs that improve appearance. (Replace torn, missing or broken shingles, throw some fertilizer and grass seed on bare spots in your front lawn, replace tile that has worked loose from the bathroom walls, etc.)

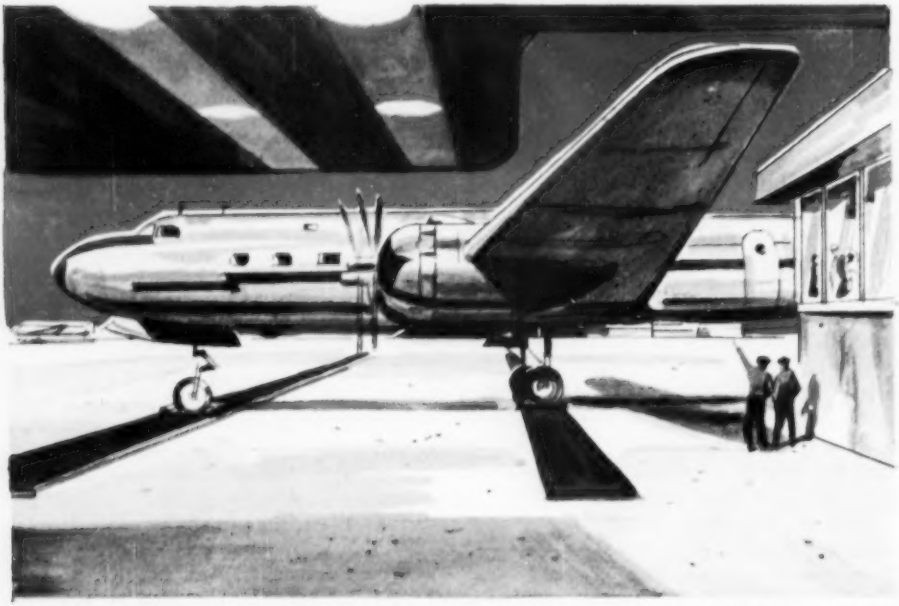
Do paint the outside if it needs it, but leave the inside as is. Women have their own ideas on decorating rooms, and most families have rugs, sofas, and other furnishings that demand particular color treatment.

Don't make major improvements. If you do an expensive job of modernization in your kitchen, say, it's unlikely that you'll get the cost back in increased selling price. Reason: You're paying for a new kitchen—but the buyer sees it as a secondhand one.

Don't clutter your house when you're showing it to buyers. (Decorators of model homes use only a very few pieces of furniture, because underfurnishing makes a room look larger than it is.)

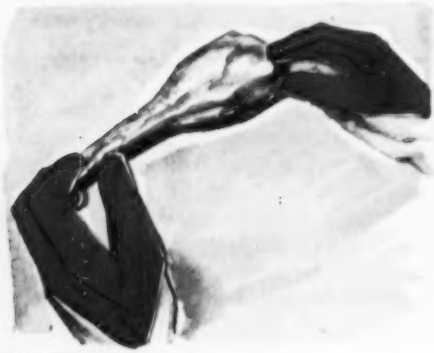
Get the trade-in offer for your house in February, March or August. Here's why: Summer and winter are slow seasons for house sales. Visit a builder as his slack season draws to a close, and he'll be inclined to put a high figure on your house; he knows he'll have the entire busy spring or fall season to sell it.

New Ideas from the Inventors

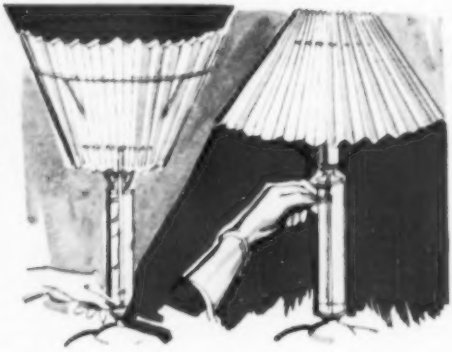


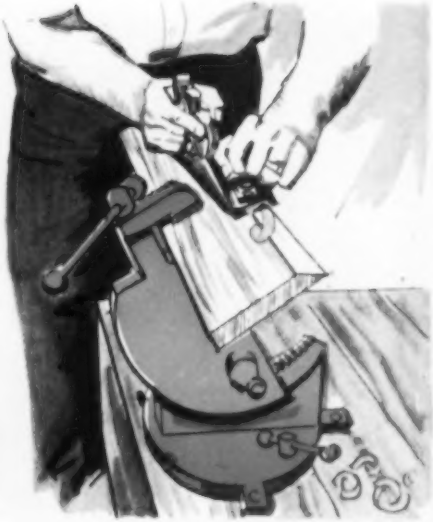
1 Moving "Runway" to Speed Traffic. Lateral, endless-belt conveyors like these might whisk airliners from their landing strips right up to the passenger gates of a terminal building. A shed overhang would protect passengers and cargo in any weather, and direct loading could speed traffic and shorten stopovers.

2 Napkin to Fit Your Fingers. Aimed at the bird-in-hand school of chicken eaters, this disposable food holder would slip onto the thumb and first two fingers of either hand. The three-finger "glove" could be made either of thin plastic film or of absorbent, napkin-type paper.



3 Shade to Beam or Spread Light. By sliding this pleated lampshade up or down on its stand, you could make it flare out at either top or bottom. If you wanted direct light, you'd broaden the cone at the base; for indirect room illumination, you'd simply invert it.





4 Nail to Clinch Itself. Sinking the head of this flat, folded nail would drive a clinching prong, part of one leg, through a slot in the other. Rising at an angle to the shaft, the prong would lock the nail securely, even in materials such as softwood or insulating board.

5 Vise Jaws to Tilt. With this bench vise you wouldn't have to twist around to get at a side or angle of your work. Instead, you'd just crank the jaws to whatever position you wanted. A rack and pinion would let you move—and lock—the vise on its arc-shaped base.

6 Door Guard to Guide Car. These garage-door guides would ease the job of piloting a wide car through not-so-wide garage doors. The device would consist of several rubber balls threaded on springy rods. They'd be mounted to help you judge clearance—and to cushion scrapes if you happened to misjudge.

Please turn the page for more new ideas

More Inventors' Ideas

7 File to Signal Missing Records. A light on the outside of this file drawer would tell you when any folder was missing. Properly filed, each folder would separate two metal-cornered dividers. Removing an item would permit the tabs to touch and close the light circuit.

8 Lug Wrench to Lift Wheel. The hairpin-shaped handle of this lug wrench would have two extra U bends that could serve as the fulcrum of a lever. After you had removed a wheel, you could use the tool, as shown below, to lift the new wheel onto its studs.

9 Ladder Parts to Adjust to Job. Socketed fittings would let you adapt both the length and support members of this sectional ladder to your need. Top fittings would include the pronged, flat, and pole-gripper types shown; extra feet would help steady the ladder.

The following patents *have been issued on these inventions: 1. Patent No. 2,750,135 to Herbert W. Anderson, Chicago; 2. No. 2,751,592 to Joseph E. Longstreth and Albert E. Honour, NYC; 3. No. 2,714,154 to Erick Johnson, Coral Gables, Fla.; 4. No. 2,711,115 to Emanuel Gisondi, NYC; 5. No. 2,750,924 to Vincent J. Di Ruscio, Healdsburg, Calif.; 6. No. 2,706,462 to Dwight J. Evans, Milwaukee; 7. No. 2,708,747 to James M. Moon, Graham, N.C.; 8. No. 2,701,707 to A. A. Miller, Dayton, O.; 9. No. 2,744,674 to J. E. Smith, Huntington, W. Va.*

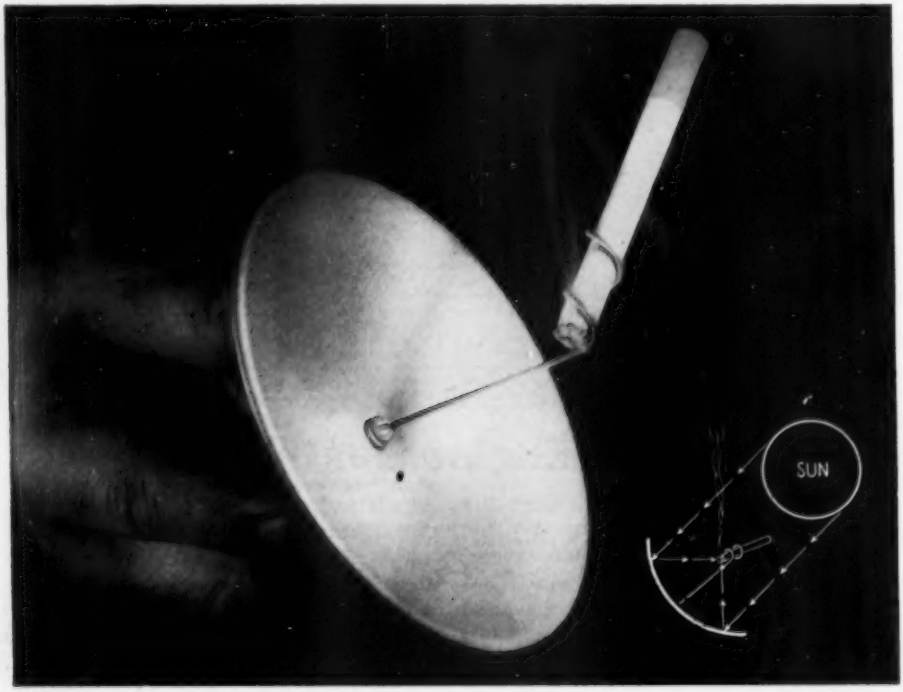
Copies of these patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C. at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

Copter Fire Engine Beats the Blaze

SAVING the pilot or crew from the flaming inferno of a crashed plane calls for speed. In recent demonstrations, a specially equipped Kaman HOK-1 helicopter did the job in less than one minute, as shown in these photos.

Arriving at the scene (1) the craft drops dry-chemical fire-extinguishing equipment. As it lands (2) a three-man fire-fighting team leaps out and unreels hoses. Aloft again, the hovering copter uses its whirling rotors to beat down the flame (3). With flames lowered, the rescue team can close in (4) and rescue the pilot, here a life-size dummy (5). Elapsed time: less than 45 seconds.

New Aids to Living

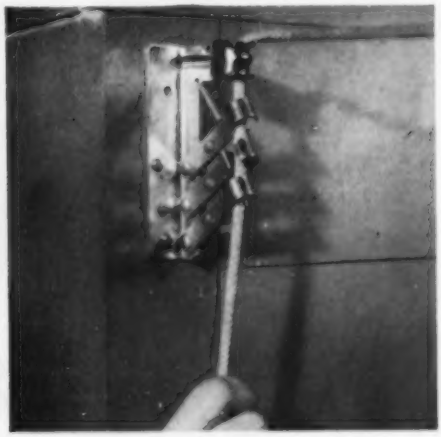


1 Solar cigarette lighter gives you a smoke without resort to matches on bright sunny days. Its pigtail-like wire holder puts the end of the cigarette at the exact spot where the sun's parallel rays converge on reflection—like diffraction through a magnifying glass, but in reverse. Don't be tempted to use the little table gadget for an ash tray, or you'll dim the reflector. And at night or on dull days, better settle for a match or more conventional lighter.

2 Steel door, said to be the first designed for the front entrance of a home, should be proof against shrinking, swelling and warping. All steel, it is rock-wool insulated, zinc coated and finished with a prime coat of baked-on enamel. You also get in the package a steel frame with factory-applied bronze weatherstripping and an aluminum threshold with a plastic seal.

3 Lacquer for plastic can be brushed or sprayed on windscreens, canopies and other translucent plastic paneling to restore the luster lost to outdoor exposure. The lacquer comes either clear or in colors. The latter deepen the color of the plastic, cutting down heat and providing increased shade.

4 Anti-slip grips snap on to keep sportsmen and outdoor workers upright when the going is slippery. Made of steel, the cleats bite into snow, ice, mud or grass. They stretch enough to snap tight over edges of sole and heel.



5 A taut line is no problem if the rope is threaded through a tightener like this. Three movable fingers grip the line. A spring pulling them upward puts pressure on the rope, clutching it in place so that it can't pull out or sag.

More information *about the products shown on these pages can be obtained from: 1. Garret Thew Studios, Westport, Conn.; 2. Steelcraft Mfg. Co., 9017 Blue Ash Rd., Rossmoyne, Ohio; 3. Resolite Corp., Zelienople, Penn.; 4. Niagara Products, 510 Niagara St., Niagara Falls, N.Y.; 5. Efess Distributors, 3017 Moffat Rd., Toledo 6, Ohio.*

Bit by bit they edged him down the steep way, and across to the car.

GUS SKIDS INTO TROUBLE

By Martin Bunn

DOC SNODGRASS, a retired physician of the horse-and-buggy school, whose waspish exterior covered a heart as large as an oaken water bucket, was having his tank filled at Gus Wilson's Model Garage when he was called to the telephone. A moment later, he came rushing out of the garage office with a speed that belied his 60-odd years, and leaped into his car just as Gus hung up the gas hose.

"Climb in, Gus!" the aged physician snapped. "Don't stand there goggle-eyed, man. This is an emergency."

The car zoomed away even as Gus hit the seat beside Snodgrass.

"The old fool," Snodgrass declared as he took a corner with howling tires. "Chasing around in the hills after those dogs at his age!"

Gus didn't need to ask who "the old fool" was. Since Doc had retired, there was only one man in the country who would call for him in an emergency, only one man who could arouse the old physician to such activity as this. That man was Todd Meacham, boyhood chum of Doc's, and now his constant hunting and fishing partner.

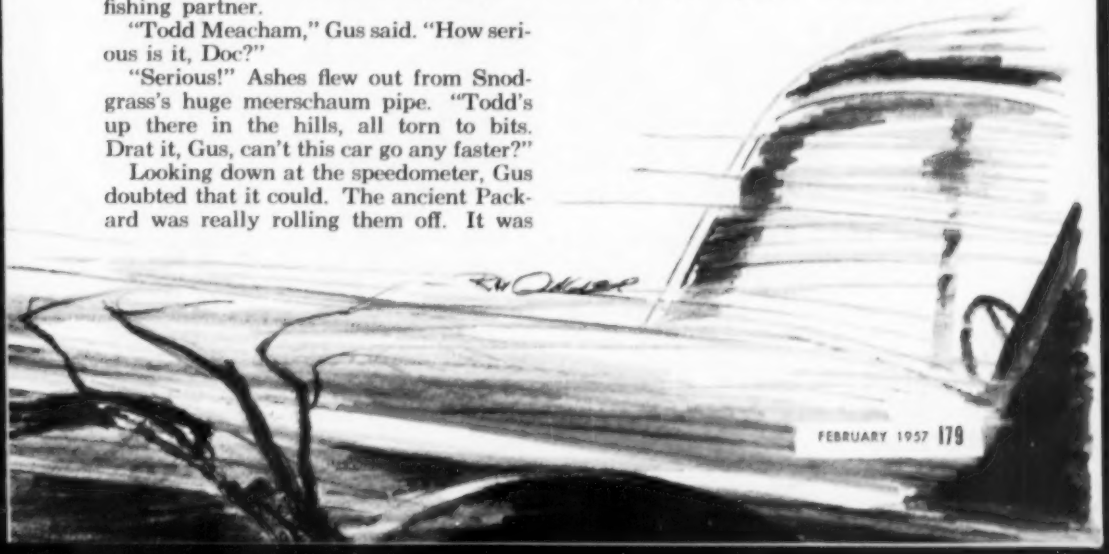
"Todd Meacham," Gus said. "How serious is it, Doc?"

"Serious!" Ashes flew out from Snodgrass's huge meerschaum pipe. "Todd's up there in the hills, all torn to bits. Drat it, Gus, can't this car go any faster?"

Looking down at the speedometer, Gus doubted that it could. The ancient Packard was really rolling them off. It was a ride that Gus would long remember—the old horse-and-buggy doctor tooling the long-snouted old car down the highway, off on a branching, graveled road, up on a dirt trace into the timbered stretches of the back country's snow-clad mountains which stood out in bold relief in the late afternoon sun.

"TODD'S been following hounds since he was knee-high to a bobcat," Snodgrass told Gus as he drove. "Ain't likely to quit, neither, until they slap him in the face with lilies and slow music. He's been after that killer black bear that's been raiding stock in the hills these past three years. From what young Barstow told me over the phone, he's finally caught him—right in the belly."

They were driving on a dirt road now that Gus hadn't even known existed. It was the kind only men like Alex Snodgrass and Todd Meacham would know about—a hunter's road, lonely and long forgotten, that rabbited upward, overhung by winter-naked brush that reached out to slap at the windshield. The trace was bare of snow by now, but six inches or more of the white stuff still lay in the shelter of the forest. The day had been warm, bringing to the trace a thin



covering of water that the old Packard sprayed to both sides as Doc hit the throttle hard.

"The Barstow kid was with Todd when it happened," Doc said as he topped a steep ridge and shot down a steep incline. "The kid was so excited and exhausted that I couldn't find out over the phone exactly what did happen, but it sounded as if Todd got to close quarters with the bear, probably trying to save one of his hounds, and the beast brought him down. The kid ran six miles over the mountain to phone me from Widow Bracken's place—he was completely played out and I ordered him to bed. All I know for sure is that Todd's lying somewhere in the brush on Tempest Creek."

AS THE car plummeted down into the deep ravine of Tempest Creek, the ridge behind them shut off the rays of the westering sun and the air carried the bite of the approaching February night. Snodgrass slowed the car now, driving with his head out the window, eyes searching the roadside. Suddenly he yanked on the brake and cut the motor, leaped out. Gus hastily followed him, to find him kneeling there, looking at the huge, almost human footprints of a bear, mingled with the spoor of Meacham's hound pack.

"The chase crossed here," Doc said, and started to move in to the brush. Gus laid a restraining hand on his shoulder.

"The bear?" he queried. "Are you armed?"

The old physician snorted. "That bear didn't tangle with Todd Meacham and come off scot-free. Young Barstow said it was dead."

They fought through brush and fallen timber, following the signs of the chase plainly written in the snow. And then, at last, they found him, lying in the brush, his dogs about him, lop-eared and sad-eyed, moving restlessly about, pausing now and then to worry the great furred beast that was stretched out near the injured man.

"Hello, Doc," Todd Meacham said weakly. "I knew you'd come."

"Serve you right if I didn't," Snodgrass snapped as he knelt down with swiftly probing fingers. "Where'd it get you, Todd?"

Meacham didn't answer. His supporting elbow fell away from him and his head rolled back into the trampled, bloody snow.

"Gus!" Doc's cry was urgent. "Quick —my bag!"

IN THE next few minutes Gus came to realize that whatever the old physician's age, he was still a doctor to the tips of his skillful fingers. A hypodermic was swiftly given. The hasty handkerchief tourniquet that young Barstow had bound about Meacham's lacerated arm was replaced with a proper bandage. Four broken ribs were probed and bound.

"Got a knife, Gus?" Snodgrass snapped. "Good. Cut branches for a litter. Quickly, now—this man has lost a lot of blood and is in shock. We've got to get him to the hospital, and fast."

They got him out, but not fast. An unconscious man of Meacham's size, with four broken ribs, is not quickly moved through forest tangle. Bit by bit they edged him down the steep way, and across the flat to the car.

"Put that box of groceries in the rear deck, Gus," Doc panted. "We'll put him in the back seat."

They had a time of it there, turning the long-snouted car around on the narrow trace. Snodgrass drove slowly now, easing the car over bumps. It was nearly dark when they hit the last steep pitch up to the summit of the range—after that, grades would be down. They made it halfway up, and then the wheels spun. Doc cursed under his breath, nursed wheel and gears and throttle. They made a few feet, spun and slewed, made a few more and then could go no farther.

"Ice," Gus said. "With the sun down, the water on the road has frozen. You'll save time, Doc, by putting on your chains."

"Chains," Snodgrass groaned. "I have no chains with me."

Gus climbed out, put his shoulder to the rear of the car while Doc tried again. It was no use—the ancient vehicle was too heavy for any pushing.

Next, Gus took the wheel, using every driving trick at his command, but the steep pitch and glare ice made it useless. Gus got out, opened the rear deck.

"Have you anything in here, Doc, that we could use?" he asked. "Rope, wire, cable?"

"Nothing. If he dies, Gus, I'll never

forgive myself. Why didn't I remember to get chains?"

Gus knew why. In that terrifying moment when he'd answered the telephone, Doc Snodgrass had almost gone into shock himself. There had been nothing on his mind but the fact that his old friend was badly injured, and that he was still a doctor. Now Todd Meacham groaned hollowly in the back seat and Doc Snodgrass went to him.

GUS flashed his pencil light about in the trunk of the car, searching for something that might help get the Packard over the ridge. He moved the box of groceries about so that he could peer into the dusty corners—a few rusty tools, hunting boots, a tattered hunting coat. Gus ripped pieces from the coat and wrapped them around the rear wheels.

The cloth, torn to shreds, flew from the spinning wheels. He tried branches under the wheels, and when that didn't work, searched in vain for rocks or gravel. At last he reached into the rear seat to shake Snodgrass by the shoulder.

"It's no use," he said. "I'd better hike out for help."

"No!" Doc's voice held a note of terrible urgency. "Get this car over, Gus! You've got to do it, somehow."

Once again, Gus probed through the rear deck, hoping to find something that he had previously overlooked. His light beam fell on the box of groceries.

"Ah!" he said softly.

He dug into the box, brought out a large bottle, opened it, poured some of its contents on a torn piece of the hunting coat, swabbed it around the rear tires, got in, started the motor.

"Hang on, Doc," he said. "We may be going over the top this time."

THEY went up, slowly, skidding and spinning at times, but they did go up. Gus stopped several times on the ascent to apply the contents of the bottle to the rear tires. At last they topped the ridge, came down into the valley.

Gus waited a long time at the hospital after they had taken Todd Meacham in. He broke the monotony, and anxiety, of the wait once, when he disappeared for a few minutes. Almost immediately on his return, Doc Snodgrass emerged from the operating room, boiling mad.

"Ungrateful old coot!" he fumed. "He's raising Cain because we didn't bring out those dratted dogs, and that bear. If you ask me, we should have left Todd in there to eat it—raw. Say, how did you manage to finally get the car over that icy ridge?"

"Easy," Gus grinned, "after I found that two-quart bottle of household bleaching fluid that you were taking home to your wife. To tell you the truth, Doc, I didn't know whether it would work or not. While I was waiting for you, I went down to the druggist to see if I could find out why it did work. He told me that this bleach is made by electrolysis from a dilution of salt, and that it will do a faster job cutting into ice than salt will, although of course it's more expensive. It sure handled our emergency.

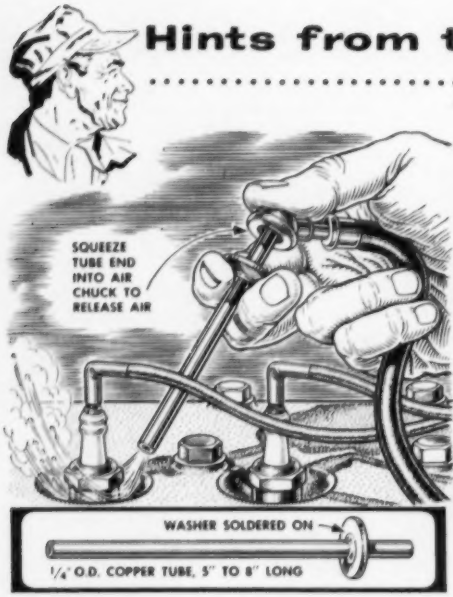
"While I'm here, could you fasten this on a little tighter?"

"You know, Doc, a man meets a lot of folks in the garage business, hears a lot of tales. A traveling salesman told me about this use of bleach on tires when fighting ice. At the time, I figured he was probably pulling my leg."

"Thank heaven he wasn't," Doc Snodgrass said fervently. Then he grinned. "You know, Gus, that was one traveling-salesman story worth listening to." END

Next Month: Gus fixes a traffic ticket.

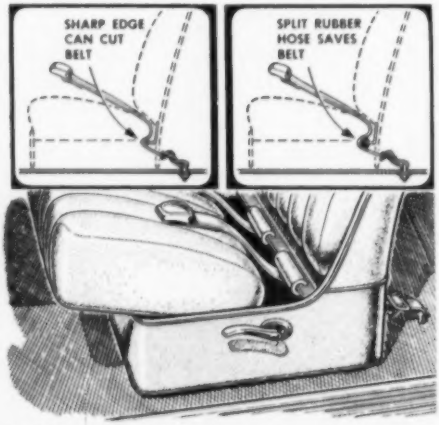
Hints from the Model Garage



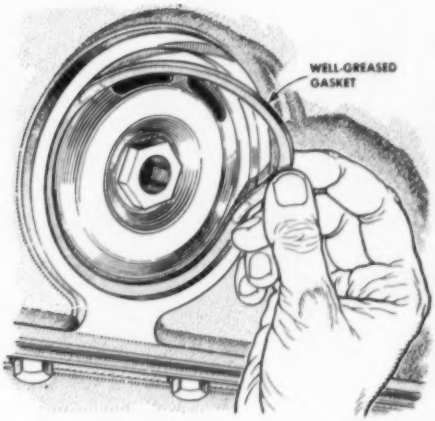
Use this blow gun to get dirt out of spark-plug recesses or to clean parts. It's inserted into a filling-station air-hose chuck, and, when pressed in, directs the blast of air where needed. A washer soldered to the tube serves as a trigger.

Stick reflective tape on the inside of a gas-cap cover that swings out. If you get stalled on the road at night, open the cover to warn cars approaching from the rear. If your cover doesn't open outward, stick tape on the edge of a door.

Keep the sun from fading one side of your car more than the other when you park in the same spot every day. By *backing* into the space every other day, you can equalize the fading, as both sides will receive the same exposure.

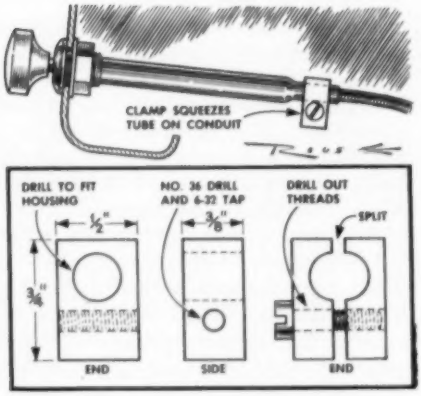


Protect safety belts from chafing on the sharp edge of a metal seat frame, or they may cut through under strain. Slit short lengths of heater hose and force them over the metal edge where the belts come through the seat.



Stick gaskets in place by applying a coat of clean grease to the side that joins the part being installed. The grease makes the gasket adhere, but does not affect the seal. This trick is especially good in places that are hard to reach.

An iron-on patch makes a neat repair over frayed upholstery. If the color can't be matched, cut a large patch from a harmonizing color to make a two-tone design. Back up the patch by stuffing crumpled newspaper into the spot.



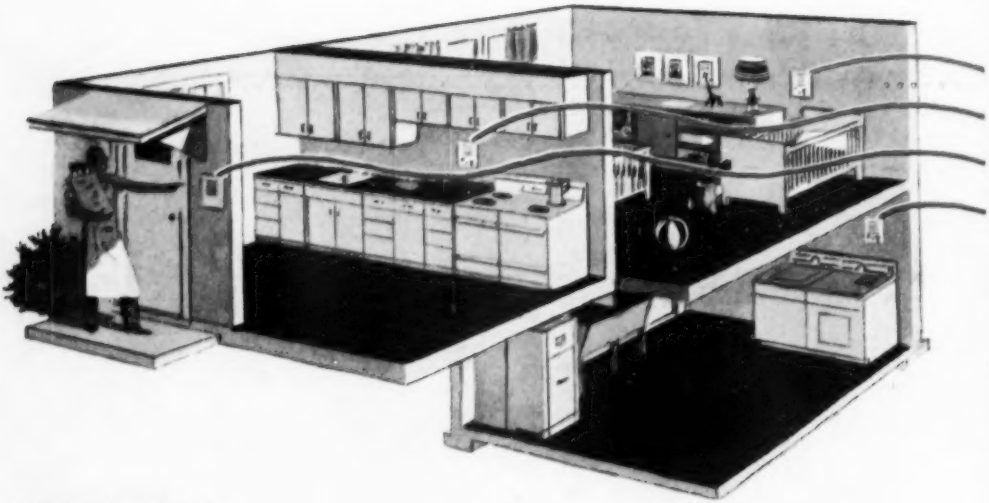
A flexible cable that's pulled loose because of too much yanking can be repaired with a clamp made from a block of steel. Machine as shown and tighten it around the housing neck to squeeze the metal tight on the flexible section.

Do You Have an Auto Hint? Send It in and Win a Prize

HAVE you discovered or developed a money-saving short cut for making your own auto repairs? Have you found an easier way to do a difficult job? Got a tip that will make driving safer or easier? Or do you know someone who has?

POPULAR SCIENCE will pay a cash prize of $15 for every auto-repair hint accepted for publication each month in Hints from the Model Garage.

Describe your hint as completely as you can in words. Add a pencil drawing, or shoot a photo, if you feel that this will make it more easily understood. Address your entry to Model Garage Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Ave., New York 10, N. Y.



Home and Shop

A burglar? The tub running over? You can hear every little activity in every room by—

Wiring

By Jerry Parker

YOU are in your favorite easy chair when the doorbell rings. You press a button below a speaker grille set in the wall and ask: "Who is it?"

Through the speaker grille comes the voice of a salesman, picked up by another speaker above the front door of your home. Without getting out of your chair, you tell him you're not interested in buying an electric guitar.

Your wife is out. She's asked you to keep an ear on the nursery. A wall speaker close to the crib reassures you that the baby isn't climbing out of bed.

These are only two of the step-saving conveniences of a house that's wired for sound. And if you think that installing a home intercom system like this is a chore for an electronics wizard, you're wrong. Today you can buy an intercom kit and do the job yourself.

These kits contain everything—amplifier, radio tuner, speakers, rough-in boxes, cable, hardware and step-by-step instructions. It takes only a little know-how (and no electrical knowledge) to hook one of them up.

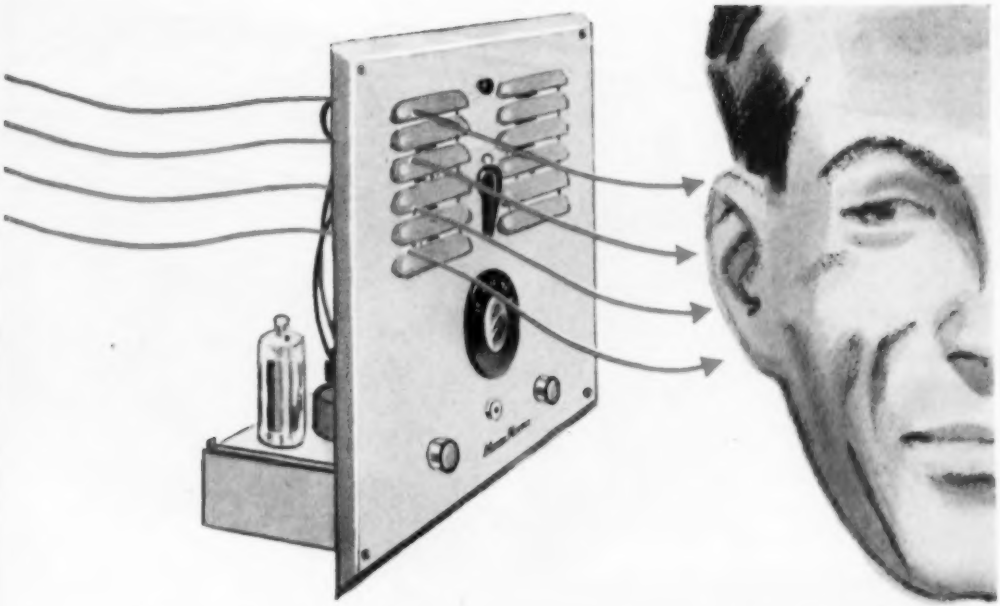
Prices range from around $150 for a five-station intercom, to $1,125 for an elaborate hi-fi job. Once installed, such a system draws so little current that there's no point in ever turning it off. For the cost of burning a 40-watt light bulb, every room in your house can be within earshot 24 hours a day.

Here are a few of the advantages:

• There's a telephone call for you, while you are in another part of the house. Maybe all that's needed is a short answer. The person taking the call has only to hold the phone near a speaker to relay your reply.

• You don't want to miss the beginning of a special television program. If you leave the TV set for a few minutes, a unit will let you know when the program starts.

• A pot boils over in the kitchen, the



Your Home for Sound

washing machine is on "rinse," or the automatic coffee maker has stopped perking. Your wife knows it, pronto.

• It's time for your wife to turn off the roast, or for you to start for the lodge meeting. An alarm clock or a timer set in front of any speaker unit will broadcast the fact throughout the house.

• Burglar alarm. The intercom will relay suspicious sounds to you.

Apart from such uses, all of these intercom kits offer a real bonus—a radio tuner and phono jack in the master unit. If you wish, you can fill your whole home with music. Volume is controlled independently at each speaker unit. To put the system back on intercom, you push a "talk" switch on the master unit.

Some kits offer even more. One provides FM as well as AM radio reception. Another has a built-in automatic timer to turn electrical appliances on and off. There's even a system that doubles as an automatic electronic fire alarm. If the temperature reaches 120 degrees in any room where a speaker is located, a 2,000-cycle warning tone is set off.

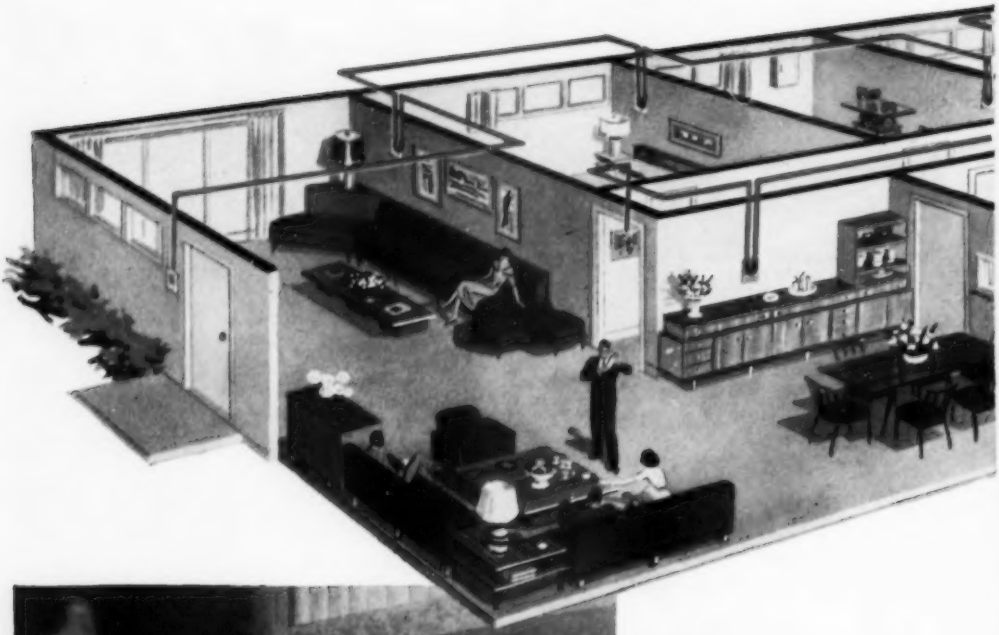
Home intercom kits are made by manufacturers in many parts of the United States. You can get them through building and electrical-supply houses, radio and TV parts distributors.

Or you can go directly to the headquarters of any of the manufacturers. Some of them are listed below.*

It doesn't require an expert. Under most circumstances, installation is no more difficult than saying "Guglielmo Marconi." You simply mount the master unit and speaker units in the walls and connect them with cable. A 110-volt AC electric line must be run to the master radio unit to supply juice for the system.

If you make the installation while your house is being built, the job is a

**Home Music System, Inc., 646 Madison Ave., Memphis, Tenn.; Talk-A-Radio, 4902 Greenville Ave., Dallas, Tex.; MusiCall Corp., 324 S. Beverly Dr., Beverly Hills, Calif.; Melody Master, 312-314 Mt. Pleasant Ave., Newark 4, N.J.; MusiTalk, Fanon Electric Co., Inc., 98 Berriman St., Brooklyn, N.Y.; Phillips Distributors, 1100 Custer Dr., Toledo 12, Ohio; TransTel Corp., 736 N. Highland Ave., Hollywood 38, Calif.*



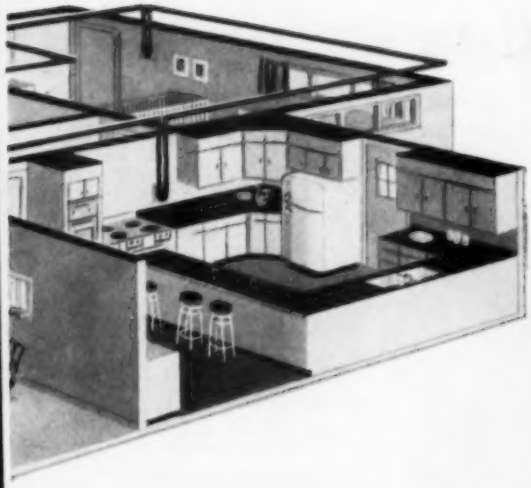
AN INTERCOM SYSTEM can reach into every room in the house—as the drawing shows. The heart of the system is a master unit like the one at left. It includes a speaker, amplifier, radio tuner and phono-jack receptacle. A dial and knobs select stations (this model has seven), control volume, turn the system on and off, change from "voice" to "music."

breeze. You nail the rough-in units to the studs, run the cable to each location, and install the radio and speakers when the walls are finished.

More likely, your house is already built. Putting in the intercom system is still not difficult. Get out your saw, brace and bit, and screwdriver. Here's the installation technique for a typical kit—the Musi-Kom de luxe outfit, made by the biggest manufacturer in the field—Home Music Systems. It costs around $300, and includes a master radio unit, five room-speaker units, and one front-door speaker.

The master unit is a compact, five-tube superhetrodyne radio, 11½″ by 13″. Speakers are 7″ square. The entire system works as intercom and radio. In addition, the front door may be answered from the master unit, and from two of the room-speaker units. It also has the built-in fire-alarm feature.

Pick the locations for your master unit and speaker units. Under most conditions, 4½′ from the floor is about the



"DAD'S IN THE WORKSHOP, hold the phone." Junior pages him through the intercom, then holds the phone up to the speaker to relay a short call. Not recommended for gabfests!

right height. The master unit usually goes in the kitchen or den.

The master unit must be mounted in a 4″ wall, but the speaker units may be mounted in 2″ walls.

It's best not to install more than one speaker in a wall. If you have to, leave at least three studs between speakers.

Cut the hole for the rough-in box of the master speaker and run electricity to this spot. If you don't want to tackle this job yourself, an electrician will do it. It's a low-cost job.

The electric line is run into a receptacle in the rough-in box of the master unit. Just let the box hang there for a while. Cut circular holes 6¾″ in diameter for each speaker unit. If possible, run the connecting cable through the attic. Second choice is the cellar. If you have a modern house with no cellar or attic, you may have to resort to stringing the cable along the baseboards, preferably concealed by a special base shoe.

At any rate, the cable has to be looped to each speaker location through a hole that will let you thread it between the walls. Leave plenty of slack—about 18″—at each speaker opening. The cable must be run from the master unit to one speaker, and then successively from speaker to speaker.

The cable for the Musi-Kom consists of eight individual wires within a plastic sheath. You don't cut the cable to make connections. Just strip about 8″ of the sheath, then loop the wires around the screw terminals on the units. Don't skin the wires. As the terminal screws are tightened, they cut the insulation, making perfect contacts. The wires are color coded for easy identification.

After connections are made, plug the master unit into the receptacle in the rough-in box and test the system. Sounds good? Then screw the master unit in its box, and mount the auxiliary speaker units. END

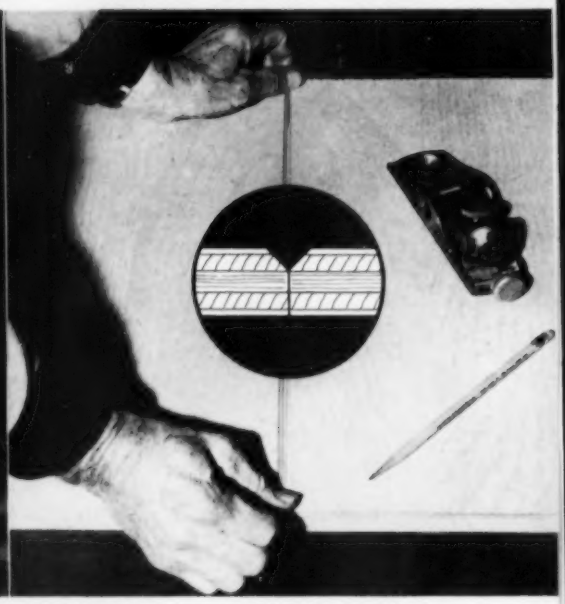
NEXT MONTH . . .

New antennas can give you a better TV picture than you ever expected to see. For an authoritative report, read March POPULAR SCIENCE.

7 Tips on Making Cabinets

Here's how the pros take the pain out of woodworking, and produce neater jobs, too.

1 WHY NAIL THROUGH SIDES into shelves—and make holes to fill? Instead, toenail through shelves from beneath. Start finish nails near corner at angle. Drive them with a nail set.

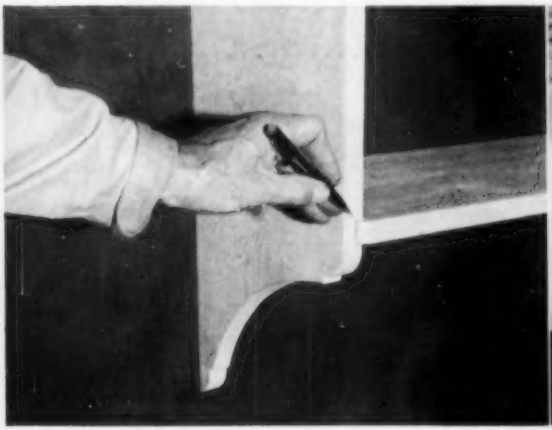


2 IT'S TOUGH TO BUTT PLYWOOD and other sheet materials neatly. Avoid the problem by planing or sanding a slight bevel on each piece first. V joint will hide small irregularities.

4 MAKE ACCURATE DADOES this way when cutting with a regular blade. Cut one side with stock against fence. Cut other against spacer block about 1/8" thinner than dado wanted.

5 RAGGED TEAR-OUTS you get when sawing plywood across the grain will spoil appearance and double the toil. Beat this by first cutting the surface grain with a sharp knife.

3 PIECES OF TRIM THAT YOU SET FLUSH with a cabinet edge will look bad if you miss by even a little. So don't try it. Instead, set such pieces back ¼" after rounding off the cabinet edge. Your trim piece will look much trimmer that way.

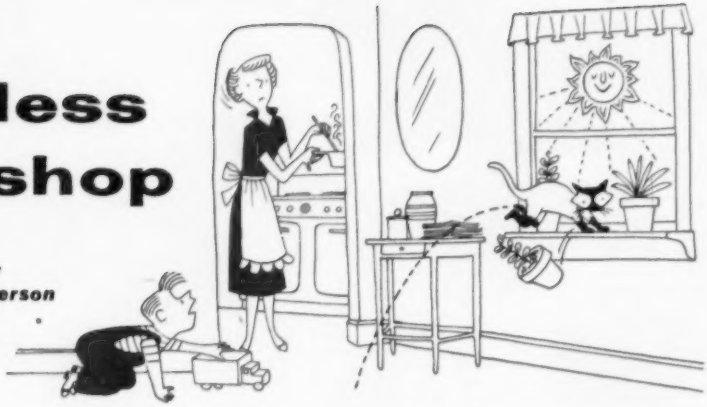


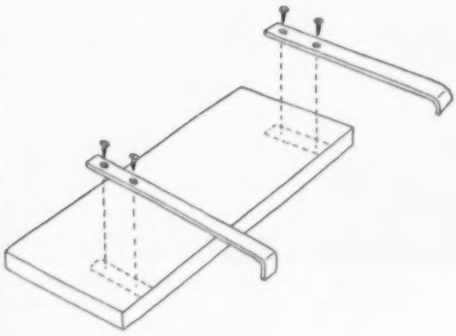
6 IF YOU SET SHELVES FLUSH with sides of cabinets, you may have tear-outs and poor fits to try to hide. So make shelves ½" wider (or set them forward). Then round off corners.

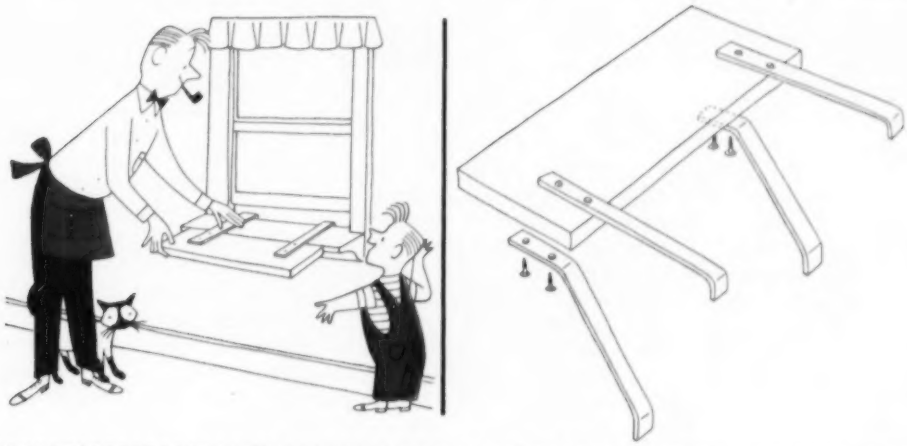
7 DO PARTS SLIP when you're fastening drawer sides to fronts? Drive nails part way at slight angle first. Complete nailing against a block. Cement-coated nails add strength.

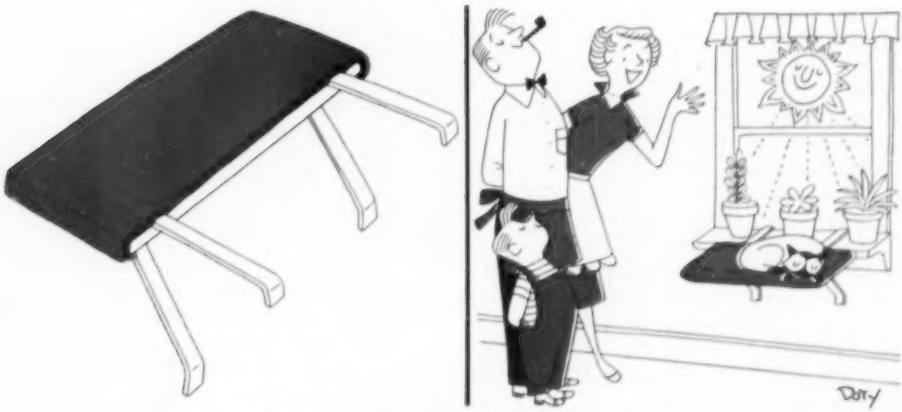
Wordless Workshop

By Roy Doty
and P. Casperson









Next Month: A tilt-out, fold-away clothes hamper for a wall

How to Patch Plaster

Here's the first vital step for a perfect painting or wallpapering job: that smo-o-oth plaster undercoat.

By Bernard Gladstone

A VERY important part of a good painting or papering job over old plaster is something no one ever sees. Professional results depend on how well you patch and fill holes, cracks and other imperfections in the plaster before you put on the first paint or paper.

This is especially true of older houses where plaster has loosened up and bulged away from the lath because of water damage or dry rot in the lath or supporting members.

Newer houses can develop imperfections, too. Cracks occur just as frequently—because of settling, shrinkage in the woodwork, accidental damage or knockouts. A certain amount of patching is always necessary after minor alterations or whenever such things as cabinets and light fixtures have been moved, leaving unsightly holes or cracks in the plaster.

Materials. Practically every plaster-patching job around the home can be done with two simple materials—a small-crack filling compound, such as Spackle, and patching plaster.

Spackle-type compounds are best for small holes, fine cracks up to about ⅛" across, minor nicks, shallow imperfections and open joints between trim and plaster.

Spackle looks much like plaster but is slower drying and easier to handle. It mixes to a creamier, more buttery consistency, and takes a smoother finish than patching plaster. It remains usable for three or four hours.

Mixing plaster. Patching plaster starts to set up quickly. So mix only as much as you can use in 15 or 20 minutes. Use it for larger cracks (more than ⅛" across), for larger holes and to replace hunks of plaster that have fallen out.

Mix the plaster quickly. Stir and turn it as little as possible or it will set up even more quickly. Avoid getting the mixture so wet and soft that it will sag or run when applied.

Once plaster starts to set up in the mixing pan, do not attempt to re-use it by adding more water or by mixing it into a fresh batch. A partly stiffened mix is useless. Throw it away, scrape the pan clean, and make up a fresh batch.

You can slow down the setting time of plaster by mixing with half vinegar and half water instead of water alone.

With spackle, it's usually safe to mix enough at once for a room. Mix the dry powder with just enough water to give a smooth but fairly stiff putty that will not sag under the knife.

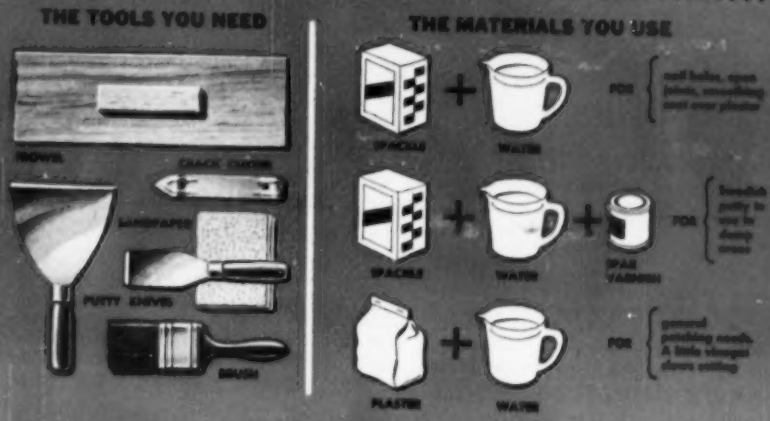
Tricks with spackle. Use a flexible, wide-bladed putty knife or wall scraper. Do not make the common mistake of thinking that narrow cracks or holes are best handled with a narrow putty knife. A wider knife enables you to bridge a larger area and will give your patch a smooth feathered edge that will blend in more easily with the wall.

Start by working a generous dab of spackling putty across the hole in one direction. After wiping the excess spackle off the knife, drag the comparatively dry

Designed to be saved for easy reference, this home-repair data sheet tells what you'll need to know about plaster repairs when the job confronts you. It's the second in a series telling how to make common repairs, and is complete in itself. Store it away in a binder along with others you'll find in POPULAR SCIENCE each month.

Next month: Replacing broken windowpanes.

Popular Science Fix-It File



How to fill a small hole or open joint

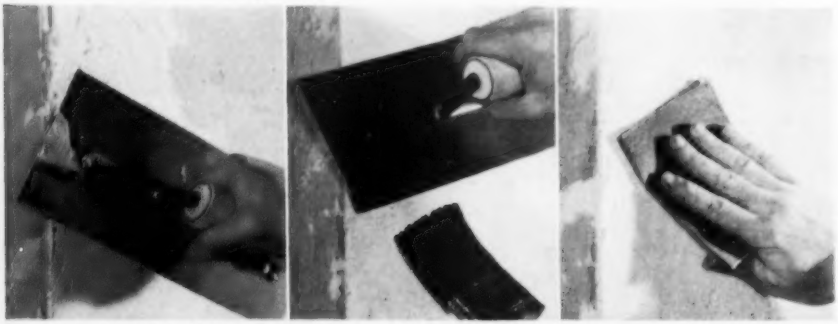
USE SPACKLE for most jobs of this kind. For a hole, work in a generous dab of fairly stiff mixture with a wide putty knife. Make a second stroke at right angles with the blade almost dry, as in the double exposure above, to wipe off excess. If spackle shrinks, apply a second time. Sandpaper smooth when dry. As seen above, your finger is your best tool for spackling open joints in corners and around trim. Wipe off excess with damp cloth or sponge. Smooth with steel wool when dry. In damp areas use Swedish putty.

How to patch a large crack

USE PATCHING PLASTER for this common job. With a beer-can opener or other cutter, undercut the crack so that the edges are firm and the bottom is wider than the opening at the surface. This will lock in the patching material. Dust out the crack thoroughly and use a paintbrush and plain water to wet down both the crack and the surrounding area. Press plaster firmly into the crack with knife at angle shown below. A wide crack should be only partly filled in the first application. After this plaster has set overnight, wet it thoroughly and then start building on the second coat. Make this slightly higher than the surrounding wall. Let dry, then smooth with medium sandpaper.

How to replace a damaged wall section

SCRAPE, CHIP OR CHISEL AWAY all loose or crumbling plaster, working with a light touch. Wet the whole area with paintbrush and water after brushing out dust and pushing through broken plaster bits stuck in lath. Press stiff patching plaster into edges first, as at right above, working toward middle. Put on just enough to bond to edges of old plaster and cover lath. Leave this finish rough to afford gripping surface for next coat.



APPLY A SECOND COAT with a plasterer's trowel after an hour. Work from bottom up, applying plaster in layers. Stop when patch is within ⅛" of level. Let this dry overnight. Substitute vinegar for half the water to mix a slow-setting finish coat. Keep leading edge of trowel slightly lifted. For glassy-smooth surface, let plaster set slightly, then retrowel while running a wet brush ahead. Keep trowel clean to assure smooth finish. Wash it frequently. Sand finish coat with fine sandpaper after letting it harden overnight. Fill any small hollows with spackling compound. Dust thoroughly before painting.

How to back up a patch in plasterboard

A BIG HOLE IN PLASTERBOARD, or a similar through hole in plaster, needs backing for the first plaster coat. So wad in paper or light cardboard. Wet around the edges of the old plaster, then press on gobs of stiff plaster. As this begins to harden, work to the center of the hole. Let it set several hours, then put on another coat to bring it almost level. Again let it set, and apply the final coat, slightly high to allow for shrinkage. Sandpaper smooth.

knife across the hole again at right angles to the first stroke. This will usually give a smooth, evenly finished patch that requires little sanding.

The spackle may shrink slightly in drying. Fill in the depression with a second light application after the first coat has dried thoroughly.

Because spackle will adhere firmly in even very shallow dents, it's ideal for such ticklish jobs as smoothing over cracked, alligatored painted surfaces or rough-textured wall surfaces. Its slower drying gives you plenty of time to work, and it is not as likely to crack out as plaster when applied in very thin layers. When large areas must be covered in this way, use a plasterer's trowel.

Patching large cracks or holes. Use patching plaster on large holes or cracks more than ⅛″ wide.

Many of these wide cracks are also deep. They should be filled in two stages to keep them from shrinking excessively and falling out.

Fill the crack halfway to the surface with the first application and let it dry overnight before applying the second and leveling coat. Be sure to wet the crack thoroughly again before applying your second coat. Since the patch is pretty sure to shrink, fill the crack slightly above the surface. After it has dried overnight, sand it down with a medium grade of sandpaper. Be sure to dust this sanded plaster off thoroughly before applying any paint.

Making large patches. Patching plaster in two or more layers is also used for replacing large patches of missing plaster—even up to about two feet square. Patches much larger than these are generally made with specially prepared plaster mixes that call for a plasterer.

Start by chipping away all the loose plaster and base coats until you have broken back to the point where the plaster is adhering fairly well. If the supporting laths are badly rotted or broken, break the plaster back to the nearest stud and nail a piece of thin plasterboard (⅜″) or gypsum lath over the old lath before replastering.

Undercut the exposed solid edge of the old plaster if possible so that the new plaster will key in securely. With a stiff brush, scrub out all loose or broken pieces before starting to plaster.

When applying your finish coat keep the working face of the trowel absolutely clean, to assure a smooth finish. Wash the trowel frequently. Wipe off the excess water each time to avoid bothersome runs in the plaster.

Swedish putty. Ordinary gypsum plaster and spackle will not stand up well in damp areas—around sinks, tubs, showers and the like.

A good answer is the waterproof spackle mixture called Swedish putty. Make it by first mixing a batch of stiff spackle with water in the regular manner. Then add two or three tablespoons of spar varnish, blending thoroughly.

The result is a dense, elastic spackling mixture which is also highly waterproof and admirably suited to kitchen or bathroom. Swedish putty is an excellent patching compound for woodwork and wood trim, too. It's frequently used for patching painted surfaces that have to stand up under exceptional abuse.

The bottomless hole. A frequent problem with plaster or plasterboard walls is the hole that has no lath left behind it against which fresh plaster can be applied. This occurs most often after a light fixture or electrical outlet has been moved.

Easiest way to handle this is to stuff enough crumpled newspaper or light cardboard through the opening so that some of it catches on the back of the partition. It will wad in the hole long enough to let you get a few globs of plaster hardened around the edges. Then you can fill the gap as you would any other large hole. END

NEXT MONTH . . .
Planning some spring digging? Spare your pocketbook and sacro-iliac. March PS gives you down-to-earth pointers on choosing and using digging tools.

How to Choose the Right Loudspeaker

HI-FI REPORT

From woofer to tweeter, the big thing is the way a speaker sounds. Here's what to listen for.

By Hubert Luckett and Robert Gorman

THERE'S an air pump in your living room that has to do a highly demanding pumping job. It's your loudspeaker, a kind of electrically driven air pump. But instead of delivering a trapped volume of air, it pushes out pressure waves that your ear and brain interpret as sound. Its job:

- For low notes it delivers pressure waves of air, each about 35 feet long, 30 or 40 times a second. These you can actually *feel* on your body.
- For high notes, it delivers pressure waves 15,000 or more times a second, each only ⅞ inch long.

Handling such a wide range of pumping rates is so difficult that no speaker can do it perfectly. Even the most expensive ones "color" the sound they reproduce. You will hear more difference between loudspeakers—of comparable quality—than you can between similar samples of other hi-fi components.

Judging a speaker is thus a matter of listening. The less color it adds to music the better, but the best speaker is the one that sounds best to you. This is true of all hi-fi components, just more so for speakers.

How to choose. You can't listen to all speakers unless you make a career of hi-fi shopping. PS surveyed 129 models and we didn't get every one.

You can decide which ones you want to listen to, though. The way they are built tells a lot about the way they will perform. We have tabulated design specifications for you on pages 198, 199 and 200. These figures are very revealing, particularly as a comparison between different models of the same manufacturer. Be wary, however, of comparing different *makes* solely by specification figures. You might be misled because standards of measurement are not uniform throughout the industry.

All speakers are made of the same basic parts. There's a diaphragm, or cone, to pump sound waves out. The diaphragm is driven by a voice coil, which operates in a magnetic field provided by a permanent magnet. How the parts are built makes the difference.

What matters. Size, first of all. The nominal size is the diameter of the frame holding the speaker diaphragm, or cone, and is a little bigger than the cone itself. Since the cone is the piston of the pump, pushing out the sound waves, you need a big cone to push out the long waves of low-pitched sound. But short, high-pitched waves are better produced by a small cone that can vibrate rapidly.

Many hi-fi rigs use several speakers. A large "woofer" handles the bass, while a small "tweeter" handles the treble. Often a medium-size "squawker" is added for the middle tones. You can get these separately, or combined on one frame into a multiple unit—a coaxial is a woofer-plus-tweeter, a triaxial a woofer-midrange-tweeter. Single "full-range" speakers that handle all tones are popular in the less expensive models.

The spec charts group the speakers in that way, by type: woofers, full-range, multiple units, tweeters, midrange.

Voice coil. This winding of fine wire gets the electric signal from your ampli-

SPEAKERS DON'T ALL LOOK—or sound—alike. Here are some of the 129 models we checked.

HI-FI SPEAKER SPECS

	Model	Approx. net price	Size[a] (inches)	Power rating (watts)	Voice coil[b]: Impedance (ohms)	Voice coil[b]: Form material	Voice coil[b]: Diameter (inches)	Voice coil[b]: Coil length (inches)	Magnetic circuit[c]: Gap length (inches)	Magnetic circuit[c]: Approx. magnet weight (ounces)	Magnetic circuit[c]: Magnet type	Magnetic circuit[c]: Flux density in gap (gauss)	Nominal frequency range (cycles)	Free-air bass resonance[e] (cycles)	Cone mass[f] (grams)	Cone-edge support or treatment[g]	Recommended enclosure[h]	Crossover frequency[i]	Tweeter: Type	Tweeter: Diaphragm material
MULTIPLE SPEAKERS																				
ACOUSTIC RESEARCH	AR-1	$185	12	60	4	phosphor bronze	2.0	1.0	.50	53	ring	10,000	38-13,000	43[r]	20	cloth	sealed[r]	1,000	cone	paper
	AR-2	$ 96	10	40	8	phosphor bronze	1.38	.625	.313	17	ring	12,000	54-12,000	57[r]	8	cloth	sealed[r]	1,000	2 cones	paper
ALTEC LANSING	601A DUPLEX	$108	12	20	8	impregnated paper	3.0	.25	.25	29	ring	11,400	32-22,000	55	15	plasticized	bass reflex	3,000	horn	aluminum
	602A DUPLEX	$126	15	25	8	impregnated paper	3.0	.25	.25	39	ring	13,500	30-22,000	42	33	plasticized	bass reflex	3,000	horn	aluminum
	604C DUPLEX	$165	15	35	16	impregnated paper	3.0	.375	.375	90	ring	14,750	30-22,000	40	33	plasticized	bass reflex	1,600	horn	aluminum
BOZAK	B-207A	$ 84	12	15	8	aluminum foil	1.5	.375	.312	24	ring	14,000	40-16,000	40	16	cloth	infinite baffle	2,500	2 cones	metal and paper
ELECTRO-VOICE	12TRXB	$ 64	12	20	16	woven glass	2.0	.313	.25	19	slug	8,500	35-15,000	50	14	treated parchment	corner horn	3,500[e]	horn	phenolic
	12TRX	$120	12	25	16	woven glass	2.5	.438	.344	56	slug	11,000	30-15,000	45	18	treated parchment	corner horn	3,500[e]	horn	phenolic
	15TRXB	$ 79	15	30	16	woven glass	2.0	.313	.25	19	slug	8,500	30-15,000	48	22	treated parchment	reflex or horn	3,500[e]	horn	phenolic
	15TRX	$145	15	30	16	woven glass	2.5	.438	.344	92	slug	13,500	30-15,000	45	24	treated parchment	reflex or horn	3,500[e]	horn	phenolic
GENERAL ELECTRIC	A1-401	$ 50	12	25	8	aluminum	1.25	.312	.25	14.5	ring	10,000	30-15,000	60	15	plasticized	bass reflex	1,500	cone	paper
JENSEN	K-80	$ 17	8	8	8	n.s.	1.0	n.s.	n.s.[d]	6.8	slug	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000	cone	paper
	K-210	$ 28	12	12	8	n.s.	1.0	n.s.	n.s.[d]	6.8	slug	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000	cone	paper
	H-222	$ 59	12	25	16	n.s.	1.5	n.s.	n.s.[d]	27	ring	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000	horn	phenolic
	K-310A	$ 40	15	16	16	n.s.	1.25	n.s.	n.s.[d]	10	slug	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000	cone	paper
	H-520	$ 80	15	25	16	n.s.	1.5	n.s.	n.s.[d]	27	ring	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000	horn	phenolic
	H-530	$130	15	30	16	n.s.	2.0	n.s.	n.s.[d]	58	ring	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000	horn	phenolic
	G-610 TRIAXIAL	$253	15	35	16	n.s.	3.0	n.s.	n.s.[d]	109	ring	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	600 & 4,000[f]	2 horns	phenolic
LORENZ	LP312-1	$ 50[r]	12	27	16	impregnated linen	1.5	n.s.	.315	63	slug	10,000	20-18,000	43	n.s.	plasticized	reflex or horn	5,000	cone	plastic
QUAM	12A6CD	$ 18	12	14	8	impregnated paper	1.0	.281	.25	6.8	slug	11,500	50-15,000	70	13.6	plasticized	bass reflex	2,000	cone	paper
RCA	SL-123	$ 58	12	15	8	impregnated paper	1.56	.30	.25	14.5	ring	11,500	40-18,000	60	11	rubber damped	bass reflex	5,000	cone	paper
	LC-1A	$190	15	20	16	impregnated paper	2.5	.50	.60	40	ring	10,000	60-15,000	45	37	rubber damped	bass reflex	1,600	cone	paper
STEPHENS TRU-SONIC	122 AX	$ 63	12	20	16	treated silk	2.0	.313	.25	34	slug	11,650	40-18,000	45	11	untreated	bass reflex	5,000	horn	aluminum
	152 AX	$ 94	15	20	16	treated silk	2.0	.50	.343	40	slug	15,050	30-18,000	40	18.9	untreated	bass reflex	5,000	horn	aluminum
	206 AXA	$152	15	25	16	treated silk	2.0	.50	.343	120	ring	16,000	20-18,000	35	18.9	plasticized	bass reflex	1,200	horn	aluminum
STROMBERG-CARLSON	RF-471	$ 50	12	32	8	aluminum	1.5	.312	.156	20	slug	11,000	30-14,000	50	14	untreated	n.s.	4,200	cone	paper
	RF-466	$ 75	15	32	16	aluminum	2.0	.312	.172	20	slug	11,000	30-15,000	40	20.3	untreated	n.s.	2,500	cone	paper
	RF-465	$ 90	15	35	16	aluminum	3.0	.55	.312	36	ring	10,000	30-20,000	35	16.5	untreated	n.s.	3,500	cone	paper
	RF-475	$180	15	40	16	aluminum	3.0	.55	.50	168	ring	11,500	30-20,000	38	22	untreated	n.s.	2,500	horn	phenolic
UNIVERSITY	308	$ 38	8	25	8 or 16	dural	2.0	.18	n.s.[d]	20	W	n.s.[d]	50-15,000	90	4.5	plasticized	n.s.	5,000[e]	horn	phenolic
	6201	$ 50	12	25	8 or 16	dural	2.0	.24	n.s.[d]	28	W	n.s.[d]	45-15,000	60	13	plasticized	n.s.	2,000	horn	phenolic
	312	$ 65	12	25	8 or 16	dural	2.0	.24	n.s.[d]	32	W	n.s.[d]	40-20,000	65	13	plasticized	n.s.	5,000[e]	horn	phenolic
	6303	$ 80	15	30	8 or 16	dural	2.0	.24	n.s.[d]	32	W	n.s.[d]	30-20,000	45	19	plasticized	n.s.	5,000[e]	horn	phenolic
	315	$132	15	50	8 or 16	fiber	2.0	.36	n.s.[d]	104	ring	n.s.[d]	30-20,000	45	19	plasticized	n.s.	5,000[e]	horn	phenolic
UTAH	G12J3	$ 40	12	10	8	fiber	1.0	.188	.25	6.8	slug	10,500	35-17,500	55	11.5	untreated	Karlson	3,500	cone	fiber
	G12P5	$ 59	12	25	8	fiber	1.5	.375	.375	21.5	ring	12,000	35-19,500	53	12.5	untreated	Karlson	2,500	cone	fiber
	G15P5	$ 65	15	25	8	fiber	1.5	.375	.375	21.5	ring	12,000	30-19,500	50	14	untreated	Karlson	2,500	cone	fiber
FULL-RANGE SPEAKERS																				
ALTEC LANSING	408A BIFLEX	$ 27	8	15	8	impregnated paper	1.76	.188	.188	11	slug	10,000	60-16,000	75	7	plasticized	bass reflex	2,000		
	412A BIFLEX	$ 48	12	20	8	impregnated paper	3.0	.25	.25	29	ring	11,400	40-15,000	55	15	plasticized	bass reflex	1,000		
	415A BIFLEX	$ 63	15	25	8	impregnated paper	3.0	.25	.25	38	ring	13,500	30-14,000	45	25	plasticized	bass reflex	800		
ELECTRO-VOICE	SP8B	$ 30	8	20	16	woven glass	2.0	.313	.25	16	slug	8,500	50-13,000	65	8	treated parchment	corner horn	4,000		
	SP12B	$ 33	12	20	16	woven glass	2.0	.313	.25	16	slug	8,500	30-13,000	50	14	treated parchment	corner horn	3,500		
	SP12	$ 65	12	25	16	woven glass	2.5	.438	.344	48	slug	11,000	30-13,000	45	18	treated parchment	corner horn	3,000		
	SP15B	$ 43	15	20	16	woven glass	2.0	.313	.25	16	slug	8,500	30-13,000	48	22	treated parchment	reflex or horn	3,500		
	SP15	$ 85	15	30	16	woven glass	2.5	.438	.344	84	slug	13,500	30-13,000	45	34	treated parchment	reflex or horn	3,000		
GENERAL ELECTRIC	S-850	$ 11	8	15	8	aluminum	1.0	.218	.218	6.8	slug	10,500	70-12,000	90	5	untreated	bass reflex	none		
	S-1203A	$ 18	12	25	8	aluminum	1.25	.281	.25	9	slug	9,000	40-9,000	70	11	plasticized	bass reflex	none		
	S-1201A	$ 24	12	25	8	aluminum	1.25	.281	.25	14.5	ring	11,000	40-9,000	70	11	plasticized	bass reflex	none		

FULL-RANGE SPEAKERS (continued)

GOODMANS	AXIETTE	$ 24	8	12	15	impregnated paper	1.0	.25	.187	22	ring	15,000	40-15,000	65	3.5	plasticized	bass reflex	none		
	AXIOM 80	$ 69	10	12	15	impregnated paper	1.0	.32	.188	n.s.	ring	17,000	20-20,000	20	n.s.	free edge	bass reflex	5,000		
	AXIOM 150	$ 54	12	30	15	impregnated paper	1.75	.438	.312	35	slug	14,000	30-15,000	35	12	plasticized	bass reflex	5,000		
	AXIOM 22	$ 73	12	40	15	impregnated paper	1.75	.438	.312	96	ring	17,500	30-15,000	35	12	plasticized	bass reflex	5,000		
HARTLEY	215	$ 65	10	20	4	aluminum, paper	1.0	.75	2.0	80	ring	14,000	1-18,000	0	6	cloth	infinite baffle	600		
JAMES B. LANSING	D216	$ 26	8	12	16	treated paper	2.0	.37	.225	8	ring	10,000	50-12,000	55	3.5	untreated	reflex or horn	none		
	D123	$ 55	12	20	16	treated paper	3.0	.37	.275	24	ring	9,500	36-15,000	36	n.s.	plasticized	reflex or horn	none		
	D130	$ 76	15	25	16	treated paper	4.0	.28	.28	52	ring	12,000	30-15,000	37	19.7	untreated	reflex or horn	none		
LORENZ	LP208	$ 20	8	15	8	impregnated paper	1.0	n.s.	.236	29	slug	9,500	55-14,000	70	n.s.	plasticized	n.s.	none		
	LP312	$ 40	12	25	16	impregnated linen	1.5	n.s.	.315	62	slug	10,000	20-15,000	42	n.s.	plasticized	reflex or horn	none		
QUAM	8A10X	$ 12	8	10	8	impregnated paper	1.0	.281	.25	10	ring	14,000	60-12,000	70	3	plasticized	bass reflex	none		
RCA	SL-8	$ 22	8	10	8	impregnated paper	1.0	.30	.25	6.8	slug	9,300	65-10,000	80	3	rubber damped	bass reflex	none		
	SL-12	$ 30	12	10	8	impregnated paper	1.0	.30	.25	14.5	ring	11,500	50-16,000	60	11	rubber damped	bass reflex	none		
STEPHENS TRU-SONIC	112 FR	$ 39	12	20	16	treated silk	2.0	.313	.25	24	slug	9,600	30-14,000	45	12.9	untreated	bass reflex	3,000		
	101 FR	$ 58	12	20	16	treated silk	2.0	.50	.343	40	slug	12,600	30-14,000	40	21.3	untreated	bass reflex	3,000		
	102 FR	$ 78	15	25	16	treated silk	2.0	.50	.343	72	slug	13,300	40-16,000	40	23.2	untreated	bass reflex	n.s.		
STROMBERG-CARLSON	RF-460	$ 20	8	12	8	aluminum	0.75	.25	.187	6.8	slotted	13,000	50-13,000	75	2.8	untreated	n.s.	none		
	RF-473	$ 35	12	32	8	aluminum	1.5	.312	.266	20	slug	11,000	30-13,000	50	10.3	untreated	n.s.	none		
UNIVERSITY	DIFFUSICONE-8	$ 24	8	25	8 or 16	dural	2.0	.18	n.s.[d]	16	W	n.s.[d]	70-13,000	90	4.5	plasticized	n.s.	1,000		
	6200	$ 24	12	30	8 or 16	dural	2.0	.18	n.s.[d]	16	W	n.s.[d]	45-10,000	60	13	plasticized	n.s.	none		
	DIFFUSICONE-12	$ 33	12	30	8 or 16	dural	2.0	.18	n.s.[d]	24	W	n.s.[d]	40-13,000	55	13	plasticized	n.s.	1,000		
UTAH	G8J	$ 14	8	10	8	fiber	1.0	.188	.25	6.8	slug	10,500	50-14,000	65	2.9	untreated	Karlson	none		
	G12J	$ 18	12	12	8	fiber	1.0	.331	.25	6.8	slug	10,500	35-14,000	55	11.5	untreated	n.s.	none		
WHARFEDALE	8" BRONZE	$ 15	8	5	10	treated paper	n.s.	.219	.188	20	ring	10,000	n.s.	85	n.s.	cloth or foam	bass reflex	none		
	SUPER 8/CS/AL	$ 22	8	5	10	treated paper	1.0	.313	.188	42	ring	13,000	50-15,000	65	n.s.	cloth or foam	bass reflex	none		
	W10/CSB	$ 40	10	8	15	treated paper	1.0	.25	.25	104	ring	14,000	30-18,000	38	n.s.	cloth or foam	bass reflex	none		
	SUPER 12/CS/AL	$ 77	12	12	15	treated paper	1.75	.50	.313	120	ring	17,000	30-18,000	38	n.s.	cloth or foam	bass reflex	none		

WOOFERS

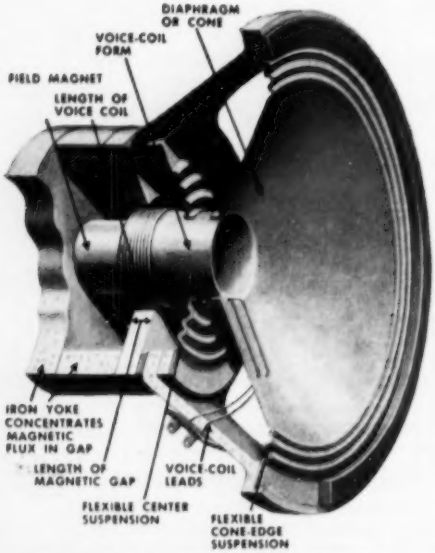
ACOUSTIC RESEARCH	AR-1W	$145	12	60	4	phosphor bronze	2.0	1.0	.50	53	ring	10,000	38-1,000	43[c]	20	cloth	sealed[c]	1,000		
ALTEC LANSING	803A	$ 60	15	30	16	impregnated paper	3.0	.375	.25	39	ring	13,500	30-1,600	45	21	plasticized	bass reflex	800		
BOZAK	B-199A	$ 50	12	15	8	aluminum foil	1.5	.375	.312	24	ring	14,000	30-4,500	40	16	cloth	infinite baffle	2,500		
ELECTRO-VOICE	12BW	$ 33	12	20	16	woven glass	2.0	.313	.25	16	slug	8,500	40-1,200	50	14	treated parchment	corner horn	1,200		
	12W	$ 65	12	25	16	woven glass	2.5	.438	.344	48	slug	11,000	35-1,200	45	18	treated parchment	corner horn	1,200		
	15BW	$ 43	12	20	16	woven glass	2.0	.313	.25	16	slug	8,500	38-1,200	48	22	treated parchment	reflex or horn	1,200		
	15W	$ 85	15	30	16	woven glass	2.5	.438	.344	84	slug	13,500	25-1,200	35	24	treated parchment	reflex or horn	1,200		
GOODMANS	AUDIOM 60	$ 50	12	30	15	impregnated paper	1.75	.438	.312	35	slug	14,000	30-6,000	35	12	plasticized	bass reflex	750		
	AUDIOM 70	$ 70	12	40	15	impregnated paper	1.75	.438	.312	96	ring	17,500	30-6,000	35	12	plasticized	bass reflex	750		
	AUDIOM 80	$ 96	15	50	15	impregnated paper	2.0	n.s.	n.s.	n.s.	ring	14,500	30-6,000	35	n.s.	plasticized	bass reflex	750		
	AUDIOM 90	$119	18	100	3 or 15	impregnated paper	2.5	n.s.	n.s.	n.s.	ring	14,500	30-6,000	35	n.s.	plasticized	bass reflex	750		
JAMES B. LANSING	130-A	$ 73	15	25	16	treated paper	4.0	.281	.35	52	slug	12,000	30-1,500	35	19.7	untreated	reflex or horn	1,200		
	150-4C	$114	15	25	16	treated paper	4.0	.318	.35	52	ring	12,000	30-1,500	39	26	untreated	reflex or horn	500		
JENSEN	P 12-NL	$ 37	12	25	16	n.s.	1.5	n.s.	n.s.[d]	27	ring	n.s.[d]	n.s.[d]	n.s.	n.s.	n.s.	ultraflex	2,000		
	P 15-LL	$ 57	15	35	16	n.s.	2.0	n.s.	n.s.[d]	58	ring	n.s.[d]	n.s.[d]	37	n.s.	n.s.	ultraflex	2,000		
QUAM	15A10L	$ 21	15	10	8	impregnated paper	1.25	.37	.313	10	ring	10,000	25-5,000	50	24	plasticized	bass reflex	3,000		
STEPHENS TRU-SONIC	120 LX	$ 36	12	20	16	treated silk	2.0	.313	.25	24	slug	9,600	20-5,000	40	11.4	plasticized	bass reflex	5,000		
	105 LX	$ 56	15	25	16	treated silk	2.0	.50	.343	40	slug	12,600	30-5,000	40	24	plasticized	bass reflex	1,200		
	103 LX	$ 77	15	20	16	treated silk	2.0	.50	.343	72	slug	18,000	20-1,200	35	19.6	plasticized	bass reflex	600		
UNIVERSITY	C12W	$ 33	12	30	8	dural	2.0	.24	n.s.[d]	24	W	n.s.[d]	40-6,000	55	13	plasticized	n.s.	5,000[h]		
	C15W	$ 75	15	50	4 to 20	fiber	2.0	.50	n.s.[d]	96	ring	n.s.[d]	30-3,000	45	22	plasticized	n.s.	2,000		
UTAH	G12P	$ 39	12	25	8	fiber	1.5	.375	.375	22	ring	12,000	35-8,000	55	12.5	untreated	n.s.	7,500		
	G15P	$ 42	15	25	8	fiber	1.5	.375	.375	22	ring	12,000	30-8,000	50	14	untreated	n.s.	7,500		
WHARFEDALE	W12/CS	$ 43	12	15	15	treated paper	1.75	.438	.375	136	ring	13,000	n.s.	30[f]	n.s.	cloth or foam	bass reflex	3,000		
	W15/CS	$ 77	15	15	15	treated paper	2.0	.625	.313	192	ring	13,500	n.s.	30	n.s.	cloth or foam	bass reflex	3,000		

NOTES: n.s. Information not specified by manufacturer
[a]In multiple speakers, this data applies only to the woofer
[b]Frequency of built-in electrical crossover network is given for multiple speakers. For single-voice-coil full-range speakers, the figure is for mechanical crossover frequency. For woofers, it is the highest external crossover recommended by manufacturer
[c]Sold only in sealed cabinet; bass resonance is given for speaker in enclosure
[d]Manufacturers state they do not provide these figures because measurement standards are not uniform, or because they feel data must be related to other design information that cannot be tabulated
[e]Has mechanical crossover in addition to electrical crossover given
[f]Speaker has three voice coils, two crossovers
[g]Model LP312-2 ($60) is similar except for dual tweeters
[h]Adjustable cutoff (at 700, 2,500 and 5,000 cycles) permits choice of crossover frequency

HI-FI SPEAKER SPECS

MODEL	APPROX. NET PRICE	TYPE	IMPEDANCE (ohms)	APPROX. MAGNET WEIGHT (ounces)	MAGNET TYPE	FLUX DENSITY IN GAP (gauss)	NOMINAL FREQUENCY RANGE (cycles)	DIAPHRAGM MATERIAL	RECOMMENDED CROSSOVER FREQUENCY
MIDRANGE SPEAKERS									
B-209	$ 48	6" cone	8 or 16	24	ring	14,000	200-3,500	paper and wool	400 & 2,500
847HF	$ 33	coaxial	16	8	slug	n.s.	250-10,000	impregnated cloth	300
848HF	$ 52	horns	16	8	slug	8,300	175-10,000	impregnated cloth	300
Midax	$ 59	horn	15	7.5	slug	11,000	400-8,000	impregnated linen	750 & 5,000
1750LH	$119	horn	16	24	ring	12,000	800-16,000	aluminum	1,200
375-537-509	$252	horn	16	112	slug	20,000	300-12,000	dural	500
RP-201	$ 43	horn	16	n.s.	n.s.	n.s.[d]	n.s.[d]	phenolic	600 & 4,000
216 625H	$124	horn	16	24	slug	20,000	600-18,000	aluminum	600
P-35 625H	$188	horn	16	72	slug	10,600	600-18,000	aluminum	600
4409	$ 30	horn	8	12	W	n.s.[d]	600-15,000	phenolic	700
T30	$ 43	horn	8	12	W	n.s.[d]	250-15,000	phenolic	350
GM8J	$ 13	8" cone	8	6.8	slug	10,500	200-13,500	n.s.	600
TWEETERS									
3000A	$ 36	horn	8	2.4	W	10,000	2,500-22,000	aluminum	3,000
802 C/811B	$ 84	horn	16	19	ring	15,250	800-22,000	aluminum	800
B-200X	$ 30	2 cones	8	8 ea.	ring	14,000	2,000-16,000	metal and paper	2,500
T358	$ 21	horn	16	4	slug	n.s.	3,000-20,000	impregnated linen	3,500
T35	$ 33	horn	16	6.8	slug	n.s.	3,000-20,000	impregnated linen	3,500
AI-404	$ 20	3" cone	8	6.8	ring	13,000	1,000-15,000	paper	1,500
Trebax	$ 27	horn	15	7.5	slug	16,000	2,500-16,000	aluminum	5,000
075	$ 55	horn	16	10	ring	12,000	2,500-25,000	aluminum	2,500
RP102	$ 29	horn	16	n.s.	n.s.	n.s.[d]	n.s.[d]	phenolic	2,000
RP302	$ 34	horn	16	n.s.	n.s.	n.s.[d]	n.s.[d]	phenolic	4,000
LPH-65	$ 9	2¼" cone	5	n.s.	slug	10,000	2,000-17,000	plastic	5,000
5A15T	$ 4	5" cone	14	1.5	slug	8,600	2,000-15,000	paper	2,000
214	$ 33	horn	16	14	slug	19,200	3,500-18,000	aluminum	5,000
4401	$ 17	horn	8	6	ring	n.s.[d]	2,000-15,000	phenolic	2,500
HF-206	$ 27	horn	8	6	ring	n.s.[d]	3,500-20,000	phenolic	5,000
GT 5F	$ 9	5" cone	8	3.2	slug	9,000	3,000-19,500	fiber	2,500
3CS/AL	$ 22	3" cone	10	42	ring	13,000	3,000-20,000	treated paper	3,000

FOOTNOTES: See preceding page



HOW YOUR LOUDSPEAKER WORKS. A sound reproducer compresses and rarefies air into pressure waves—that's what sound is. Electric signals flowing through the voice coil react with the fixed magnetic field surrounding the coil to push and pull the cone. A permanent magnet supplies the field. The cone is the loudspeaker-pump's piston. The push compresses, the pull rarefies the air in front of the cone.

fier and vibrates mechanically exactly in step with the signal. It is attached to the cone, so that the cone vibrates, too, pumping out the sound waves you hear. The important things here are:

Impedance—the effective electrical resistance. It should be close—within an ohm or two—to the impedance marked on an output tap of your amplifier.

Form. The support on which the voice coil is wound must be light, rigid and unaffected by temperature and humidity changes. Some new materials meet one or two of these requirements better than the old favorite, paper, but many makers prefer paper, partly because they feel that it adds the least coloration to the sound.

Diameter. In general, the bigger and more powerful speakers have bigger coils. A large coil pushes and pulls on the cone over a large area, giving better control of cone movement. One manufacturer uses some coils four inches across. Other makers, however, claim that a moderate-size voice coil simplifies the design of a speaker with distortion-free bass tones.

Length. The voice coil travels back

and forth within the gap between the poles of the permanent field magnet. The electromagnetic force causing this movement will be greatest if the axial length of the coil is just equal to the axial length of the gap, other things being the same.

This equal-length arrangement gives the most efficient design for a given size magnet and coil. It is fine so long as the coil does not move far. But on loud bass notes it does—¼ inch or more at 30 or 40 cycles in a 15-inch speaker. Then part of the coil moves out of the magnetic gap, into a region where the magnetic field is weaker. The force moving the coil gets weaker, too. So bass notes are distorted.

One fix is to enclose the speaker in a cabinet that reinforces bass sounds. This delivers the bass notes with less travel of the voice coil.

Another fix is to make the coil longer than the gap, or vice versa. This makes less efficient use of electromagnetic energy, but keeps the force on the coil uniform, which is what you want most.

Magnetic circuit. How quickly a speaker responds to an abrupt note—starting and stopping—depends largely on its permanent magnet. A good speaker needs a big and powerful magnet. Here's what to check:

Weight. Since nearly everybody makes speaker magnets from the same material, the weight of the magnet is a pretty clear indication of how powerful the magnet is. If you check the spec chart, you'll notice speakers of the same brand that seem almost identical—except for price and magnet. The higher the price, the more magnet you get.

Flux density. This, too, indicates magnet power. It is the magnetic energy available to work with the voice coil—the more the better.

Type. A compactly designed magnetic circuit usually puts more of the available magnetic flux into the gap, where you want it. The W-shaped magnet permits the tightest design, with the ring type second.

Frequency reproduction. Every aspect of design is involved in making the tones come out right, but a few specific points may help you choose wisely.

Nominal range. The figures listed are the advertised ones, and because of varying standards of measurement, tell

[*Continued on page 252*]

COMING SOON:

How to Tune Your Speaker Cabinet

AFTER you've picked the best speaker for the money your budget allows, the next step is installing it for best results. An article coming soon in POPULAR SCIENCE will tell you how.

It will show you how to tailor an enclosure to your speaker for maximum fidelity by using as a tool the PS Hi-Fi Test Record announced last month.

This record is available by mail for $2.50 (cash, check or money order) from Record Dept. 257, POPULAR SCIENCE, 353 Fourth Ave., N. Y. 10, N. Y.

Putting Up Cork Walls: a Paste-and-Scissors Job

CORK walls are a handyman's job for any home. You buy small, easy-to-handle tiles in a variety of shapes and shades of color. You butter the wall with cement and paste them up. You get a wall of warm, unsnooty elegance.

Most cork tiles are ⅛″ thick, the thinnest recommended for covering a wall. They come in 6″, 12″ and 24″ squares and in several sizes of rectangles (6″ by 12″, 12″ by 24″ and 24″ by 48″). You can buy them in natural or blond and in red- or green-tinged shades. They're moderately priced—about 40 cents a square foot.

The tiles make a good, permanent wall covering because they wear well, hide dirt and small nicks, and are easily washed clean. They also help to insulate and sound-deaden a wall.

With new cements, you can even put the tiles right up over water-base paint, which has not been recommended before. These cements are *not* the ordinary linoleum paste that is sometimes used incorrectly, so be sure that you get a special cork-wall cement, such as Armstrong's No. S-245.

Your wall should be as smooth and even as possible, or irregularities will show through the thin, flexible sheets. Old wallpaper should be removed. Paint, especially the water-base kind, should be sanded lightly to roughen the surface for a good bond with the cement.

Cork absorbs some moisture, so in areas subject to dampness or greasy fumes, it may be best to add a finish coat of wax, shellac or a clear-plastic spray. This will make the surface shinier, which some people don't like, but will also accentuate the highlights and tones, which some people do.—*Alfred Coda.*

START TILES at upper corner of wall and work across. To get the first row straight, measure down one tile width from ceiling at each end and stretch a chalk line to guide you.

SPREAD ON ONLY AS MUCH CEMENT as is normally left on the surface by a standard toothed trowel. Too much may ooze from joints or cause lumps. Cement sets in about 45 minutes.

CEMENT THAT SQUEEZES OUT from under previous tiles should be scraped away with the corner of the trowel. This keeps cement from building up too thickly under joints between the tiles.

LAP EACH NEW SHEET slightly over preceding tiles, then slide it slowly off these and onto the wall. Don't slide it against other tiles when positioning or the edges will scoop up the cement.

GO RIGHT OVER electrical outlets (after removing their cover plates), then cut opening with shears or razor blade. On switches, cut a small hole for the toggle, then trim later.

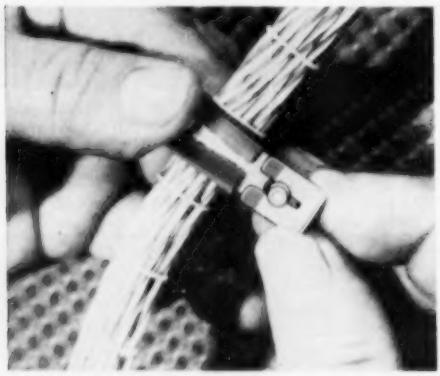
THIN CORK IS EASILY CUT to fit around openings or to make filler strips. Where edges must meet perfectly, use a straightedge or metal-edged ruler and cut with a razor blade.

SOME CEMENT WILL OOZE from joints no matter how careful you are. Wipe it off quickly with a damp cloth or it will stain. Check later to see that no more cement has seeped out.

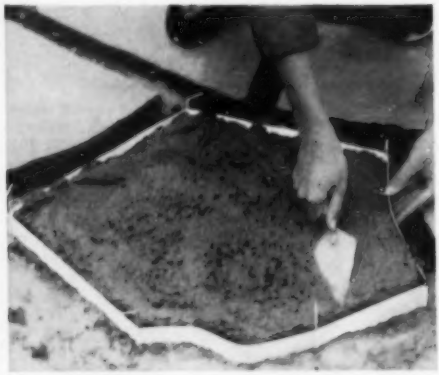
ROLL CORK DOWN HARD in all directions, both as you go along and again when the wall is finished. Many stores will now rent or lend you the roller and other tools that you need. END

New for the Handyman

1. Spray Cuts Soot in Furnace. A new chemical that is nonflammable in itself will lower the ignition point of soot in a furnace so that you can burn it out and improve heating efficiency. You spray the inside of the firebox, after shutting off the burner, and then ignite the soot with a rolled-up newspaper.



2. Clip Holds Clamp on Wire. A thumbnail-size clip of spring steel that you slip around the threads of a wire- or hose-clamp bolt will hold the tension while you make any final adjustments. You can then leave the clip permanently in place, or slide it out before drawing the nut up tight and use it over again.



3. Mold Shapes Concrete Flagstone. This form can be assembled different ways to make concrete flagstones of various shapes. It's made of strips that you hinge together with pins. After laying it out to desired shape, you place the mold on the ground, pour concrete, then trowel on color. Materials come in a kit.

More information *about the products on this page can be obtained from: 1. Stewart-Hall Chemical Corp., Box 66, Mt. Vernon, N.Y.; 2. Pastushin Industries, Inc., 5651 W. Century Blvd., Los Angeles 45; 3. Castle Patio Mold, 1001 Aviation Dr., Glendale 3, Calif.*

There was a crash and Bill sailed backward, knocking radios and toasters off shelves as he went.

High voltage, mystery and low comedy liven up work for repairmen—

When TV Transformers Play Tricks

By Art Margolis

IT'S on the picture tube that my customers watch their favorite actors. But being a TV repairman, I know a mighty interesting character right inside the set. It's the flyback transformer. It will tease you with its bag of tricks. Then, if you're not careful, it socks you with an electrical wallop.

It gets into every act. The picture you see is created by a stream of electrons slamming against the phosphor viewing screen. It's the job of the flyback transformer to supply the high voltage to hurl the electrons. And I mean high—several times the 2,000 volts used in an electric chair.

Luckily for the repairman, it's high voltage without much amperage. But it can give a jolting shock just the same—and maybe a bit of trouble on the side. Like the time when . . .

His Jerk Was Worse Than the Jolt

A FRIEND of mine who runs an appliance store was having trouble with a good but used TV that he had taken in trade. "It's okay on distance," said Bill,

"but the local stations come in whacky. Sometimes the picture looks like a photographic negative, sometimes like you were looking into one of those crazy fun-house mirrors."

Right away I could tell the trouble was with the automatic-gain-control circuit. A modern set is expected to handle signals of vastly different strengths without a lot of knob-twiddling. AGC keeps the gain constant by continually sampling the signal and adjusting the gain of other tubes accordingly.

Here, the automatically adjusted contrast wasn't working. The other tubes were running full blast. Weak stations could use this boost nicely, but strong stations were overloading the circuits and making the picture bend or go negative. After tracing through the AGC circuit, I found that the transformer was at fault.

"But it seems to be working," my friend argued. "There's plenty of brightness."

I explained that his type of flyback transformer, besides supplying high voltage for the picture, also has special circuits to match impedance, provide filament voltage, handle what we call B-plus boost, and work the AGC's chores.

For the AGC job, the transformer has a special small secondary winding, and this was broken open. So the rest of the transformer worked, but its AGC action was gone.

As I turned to get some tools, Bill had spotted the transformer and was reaching into the set. "Is this—"

He never finished the sentence. Before I could turn around, there was a crash and Bill sailed backward, knocking radios and toasters off shelves as he went.

The set was a wreck. Bill's momentary contact with over 10,000 volts hadn't hurt him much, but the jerk of his hand had torn up wiring and smashed several tubes. The bill would run up.

To console him, I pointed out his good luck—high voltage that wasn't fatal because of its low amperage and high frequency.

The higher the frequency—in this case, 15,750 cycles—the more a current tends to travel over your skin rather than through vital organs. When you short this transformer with your body, overload kills the flyback action. The jolt you get, though not sweet, is short.

I couldn't convince my friend that he was lucky, though. Especially when he got his second jolt—my bill.

TV's Cave-Man Days

I DON'T mind the tricks of today's transformers, because they're safer than the old ones. I'll never forget the first time I saw what the old high-voltage transformers could do.

I didn't get hurt myself. It was my buddy. This was right after the war. He and I were going to college and after classes we had jobs at a big radio shop.

That afternoon, my friend had just repaired an early-model TV when he accidentally touched the high-voltage lead. As if a rock had hit him, he groaned and slumped to the floor.

I ran up and pulled the power plug. Somebody phoned the hospital. In a few minutes, the ambulance raced up and carried him away, still unconscious.

Just to keep myself busy, I approached the deadly set. It had what was known as a "brute force" power supply. As a transformer, it was the simple kind you learn about in high school—just a pair of coils wound on the same iron core. When AC surges through the primary, it induces current in the secondary. When the secondary has fewer turns than the primary, its voltage is lower. When it

has more turns, its voltage is stepped up proportionately.

The brute transformer in those caveman days of TV was simply an extreme stepper-upper. Low-frequency house current went in at 110 volts and came out a lethal 7,000 volts.

I soon saw that the transformer was dead now. It had killed itself trying to kill my buddy. When his human short circuit began to draw current, the overload burned out the secondary.

I replaced the transformer. High voltage crackled again, and the tube lit up.

Just then, the hospital called. My friend was conscious again and was going to pull through. Luckily, only his right hand had touched, so the current hadn't rammed through his heart.

The fear of electrocution hung over us those days until manufacturers saw the coming market for millions of TV sets and the need for lots of repairmen.

This led to making the transformer safer than the old brutes. You hear them called flyback, kickback, pulse-operated and RF.

Technically, they're pretty fascinating, with various special windings substituting for the old-fashioned secondary. That's why it is usually best to put in a new unit rather than to try fixing the old one. That is, unless you're up against a customer acting as if his life depends on seeing pictures again right this minute.

The Set That Needed a Witness

IN BED late Sunday morning, I'm not what you would call sharp. But here was this frantic chap phoning.

So I stepped into my pants, and stepped on the gas. On arrival, a middle-aged gentleman rushed me into his living room. Pointing at a 17-inch set, he begged, "I'm in a jam. Fix it fast."

When I turned the set on, first it whistled, then spat, and went into a Fourth of July act—firecracker sounds followed by sparks and white smoke.

I pulled off the back and restored current with my cheater cord. As I suspected, the high-voltage transformer was on a rampage. It was of the flyback type, but with a slight variation called "pulse-operated."

In a standard flyback circuit, the horizontal output tube furnishes AC by turning rapidly on and off. This sawtooth current is transferred from the transformer primary through a step-down secondary winding to the horizontal yoke section, to sweep the picture from side to side. The step-down is needed to match the output tube's high-impedance load to the yoke's low-impedance load.

When the tube is on, a powerful magnetic field builds up around the yoke. Then the tube goes off and this field collapses suddenly, giving the violent "kickback" that creates a high-voltage pulse. It rockets back through the few windings of the secondary, is transferred into the many windings of the primary—and you've stepped up past 10,000 volts. In this reverse English, the step-up is from secondary to primary.

In the pulse-operated type of transformer that I was now working on, you don't need the secondary winding at all. A special high-impedance yoke is used that automatically matches the high impedance of the output tube without requiring a separate step-down winding. The primary is split into two sections. One part acts like a genuine primary. Both sections, combined, create a step-up secondary when the kickback occurs.

Either way it comes out, the high voltage is AC. But the picture tube needs DC. So we have to add a rectifying tube. It, in turn, needs current to heat its filaments. So an extra job is given the transformer. Some heavy insulated wire

is loosely wound once around the transformer core. Enough current is induced here to heat the filaments.

But sometimes the high voltage right next to it breaks through the insulation. Such a leak was giving my customer his fireworks.

I would have preferred a new transformer, but this would have taken time and probably lost me my nervous customer. So I snipped off the old filament lead, wound a substitute wire around the core, and sent juice back into the set.

It worked beautifully. The man started pounding my back happily.

By this time, visitors were knocking at the door.

"They're here to see my wife," he told me. "She's on a quiz show in a few minutes and I'd be a dead duck if I didn't catch her act."

But why the visitors?

"Eyewitnesses," he said proudly. "They'll testify I sat here really watching her, and not a ball game. You see, you don't know my wife."

I took his word for it—along with a generous fee.

The Set That Got in a Sweat

THIS TV was in the lounge room of a Turkish bath. I was worried because I had to repeat the same repair three times in two years and was wondering what this was doing to my reputation.

Each time, it was the same double trouble: Instead of a full picture, it was shrunk in on both sides. And it was dull. Turning up the brightness control just blew the picture up like a balloon.

My prescription each time had to be a new flyback. But what caused it to conk out so often?

Naturally, the bath's manager was wondering, too. First time, he blamed an overcooked customer who had stumbled into the set. But I couldn't see where the collision had hurt it.

Another time, I was told that one of the patrons had insisted on having the set brought into the steam room where he was cooking. The Brooklyn Dodgers were playing and he didn't trust them out of his sight. It was there that the picture started its shrinking act again.

I agreed with the manager that boys will be boys, but the trouble, I explained, came from less drastic causes.

The transformer was of the standard flyback type—not pulse-operated—that requires a separate step-down secondary winding. This transfers the high-impedance sweep-signal voltage from the output tube to the low-impedance yoke, for the picture-sweeping operation before the kickback to high voltage begins. It matches the two impedances just as you'd use an adapter to join two different sizes of pipe.

The trouble here was that some of these secondary windings had shorted together. This crippled the impedance matching. So all of the sweep signal wasn't being transferred—and the picture therefore shrank in on both sides.

Also, the same short was taking some of the kick out of that high-voltage kickback. The electron stream wasn't banging hard enough against the phosphor screen, so the picture lacked brightness.

I figured the steamy air from those baths was to blame for the chronic shorting. Too much humidity was condensing inside the set and shorting the flyback windings. I finally convinced the manager and he agreed to let me put in new flybacks regularly. The set didn't stop sweating—but I did. END

Split-second flash even stops milk in motion—makes dramatic shot of a routine situation.

How I Have Photo Fun with Electronic Flash

By Phil McCafferty

IT USED to be that electronic flash was only for professional photographers. Now excellent units to fit most amateurs' cameras can be bought for $29 to $75.

With electronic flash, you never buy flashbulbs. You get a brilliant, well-balanced, flattering light. But what I have the most fun with is its speed.

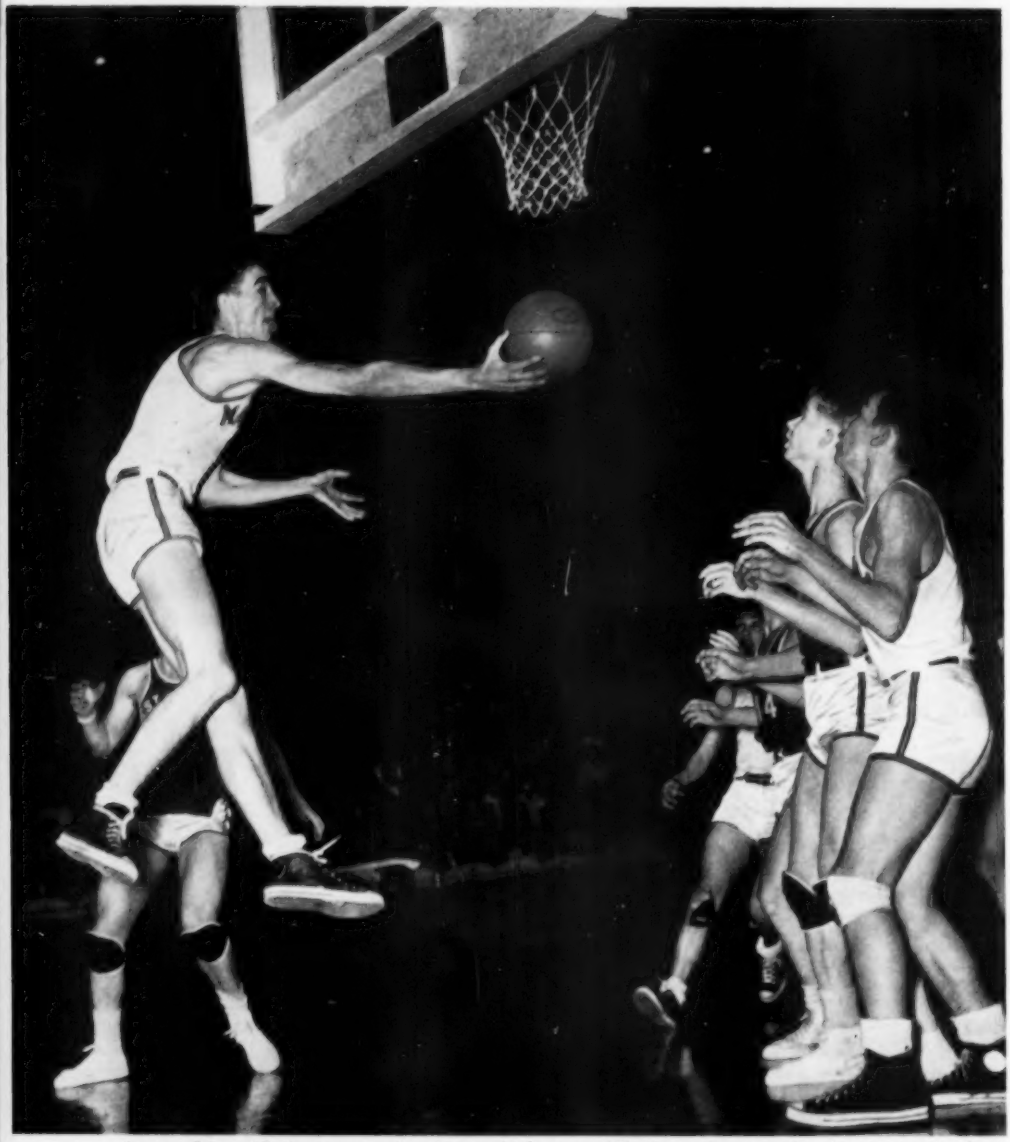
It's fast. The flash duration of most units ranges from about 1/700 second to over 1/2,000 second—much faster than most camera shutters. This means that very fast movement can be stopped dead.

Perhaps you'd like to stop sports action, analyze your golf stroke, get spectacular shots of your children in action, or check the high-speed operation of a shop tool. Electronic flash can handle all of these assignments with ease.

Outguess your subjects. Getting fast-action shots may take a little practice. Learning to anticipate future action and where it will take place is important.

If you like to shoot action at basketball games, as I do, station yourself near one of the baskets. Have your camera cocked and focused on the "expected action zone." Aim it, and as a player jumps or throws—trip the shutter release. The lightning-like flash will instantly record every thrilling movement —and humorously awkward position—that the players assume.

Get the kids into the act. Small children are perfect subjects for speed flash because it's practically impossible to get good posed shots. I find it helpful to tell them what I want, but without actually asking them to pose. An action assignment like playing football, slugging

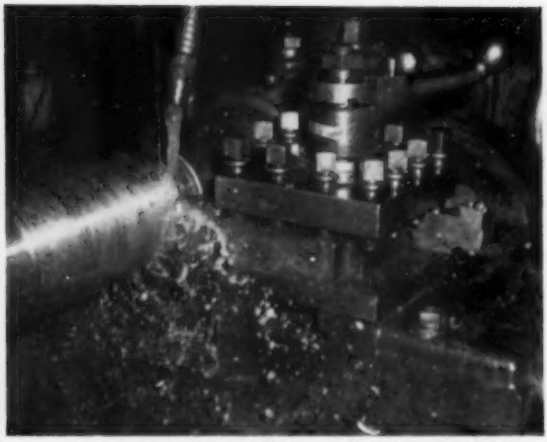


Stopped in mid-air, tense action is caught by speed flash as player makes frantic try for ball.

a baseball or feeding a pet usually makes them cooperative.

How electronic flash works. A high voltage is built up across a large-value condenser. When the circuit is triggered by the camera release, the high voltage discharges rapidly through a small pretzel-shaped flashtube filled with gas. This causes the gas to ionize with a vivid white brilliance for a small fraction of a second.

Power to charge the condenser comes from a variety of sources, depending on the unit—wet batteries, high-voltage dry batteries, flashlight batteries or 110 volts AC. Combination units let you use



"FROZEN" SPRAY from cooling liquid and flying chips of metal dramatize high-speed shop machines like the metal-turning lathe above.

CARD SPLIT BY .22 BULLET remains suspended in mid-air. Shot was made by pressing rifle trigger and camera cable release simultaneously.

house current indoors, then switch to a portable power pack outdoors.

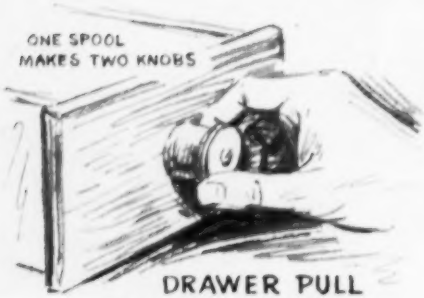
Watch out for ghosts. Shutter speed is of little importance with electronic flash. The exposure is controlled by the flash itself. It's a good practice, however, to shoot at the fastest speed available. Otherwise a "ghost image"—an extra, natural-light image—may occur when speed flash is used outdoors.

Check your shutter. Many cameras have "M" and "X" flash synchronization settings. The "M" setting means "medium delay" and allows slower flashbulbs to build up to peak brilliance before the shutter opens.

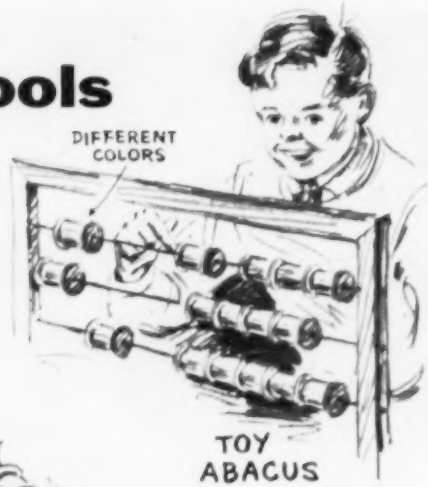
The "X" setting means "zero delay" and must be used with most electronic flashtubes so the flash will fire at the instant the shutter is fully open. END

Action-stopped shots like this tell a whole story—you just know it's going to be a homer.

7 USES FOR Thread Spools



DRAWER PULL
OR CABINET KNOB



TOY
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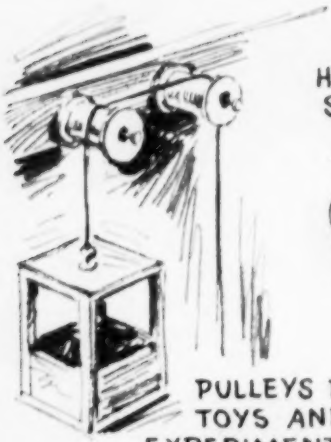
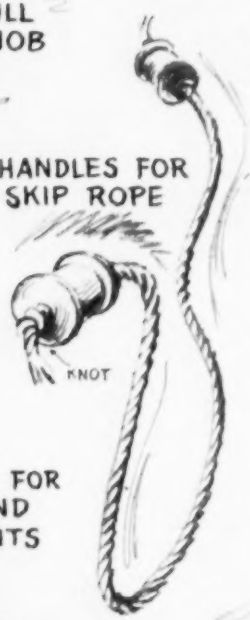
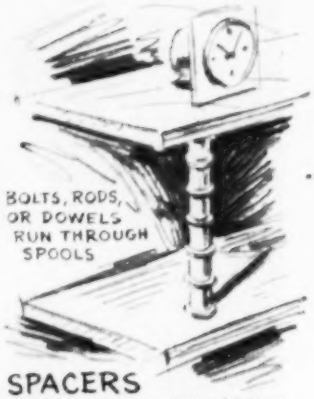


PULLEYS FOR
TOYS AND
EXPERIMENTS





SPACERS
BETWEEN SHELVES

AIR BREATHER FOR
PILLOWS AND CUSHIONS

LEGS FOR
SMALL CABINETS
AND BOXES

He Dunks Typewriters in the Kitchen Sink

A professional repairman tells how you can use professional methods to clean a dirty machine with household detergent.

By Edward M. Field

WHEN a typewriter needs cleaning, you ought to think about dunking it in the kitchen sink.

Fantastic? Not at all. Typewriter repairmen frequently do just this when reconditioning a machine. A household detergent quickly washes away all dirt.

You must strip down the machine before dipping it, dry it thoroughly, and oil it immediately afterward to forestall rusting. The dismantling procedure breaks down into these steps:

- Remove the ribbon and spools.
- Loosen setscrews holding the knobs

THE AUTHOR of this article operates a typewriter sales and service shop in Auburn, Maine.

STRIPPED FOR CLEANING, a typical chassis looks as shown above (1). Parts removed are the case (2), front panel (3), ribbon covers (4), platen (5), feed rolls (6), paper guide (7), ribbon spools (8) and platen knobs (9). Lift the platen out at right end first, as shown in the photo above, disengaging it carefully from the spacing mechanism at the left end of the carriage.

on or in the platen (paper roller). On some typewriters, only one comes off.

- Pull off the knobs.
- Draw out the platen shaft. On one model (Underwood) it won't go through the end plate; instead, push it from the left into the platen. (When replacing it, push a rod into the other end to force the shaft out.)
- Lift out the platen.
- Remove the paper guide, the curved piece under the platen. It may lift straight up, or snap out. If it is hinged it can stay, but raise it to remove the feed rolls.
- Take out the feed rolls (the rubber rollers that hold paper against the platen) if they do not come out with the guide.
- Loosen and remove the case.

To detach the case, start by taking out any screws on the back. Tip the machine up to remove any in the bottom. If the plate over the ribbon spools is hinged, you may have to move the carriage to the two extremes of its travel to get at the hinge screws.

Other machines require removing two screws under the plate, and some recent models have two screws in front, just above the keyboard.

With the machine before you, reach into the back of the case with a hand on each side. Spread it gently. Then work it forward and up, to free it from any parts it hooks under. It may help to depress all keys in the fourth (top) bank.

Removing the drawband, or cord, which pulls the carriage forward, is necessary only if it is made of catgut or in bad condition and will need replacing. In that case, detach its end from the right-hand end of the carriage, taking care not to let it snap back. Hold the spring drum firmly as you release the cord from the drum notch. Then release drum tension by letting it unwind slowly.

In front of the machine will be found a cushion strip on which the type heads rest. Remove it only if it comes easily.

Now you can dunk the stripped machine. Fill the kitchen sink, a wash basin or laundry tub with enough hot water to cover the typewriter complete-

PLUNGE THE MACHINE up and down hard several times in the detergent solution. Then use a vegetable brush to clean its type and type bars as above. Clean the sides of the bars, too.

SPRAY HOT WATER over top and bottom of machine to remove detergent. Shake off water with machine held at various angles. Flick type-bar springs gently to get water off the coils.

ly, mixing in a generous amount of woodwork- or wall-cleaning detergent such as Oakite, Spic and Span, or Soilax. Make sure all is dissolved; then submerge the typewriter.

If the keytops are white paper with black figures, covered with glass, tilt the machine (so that the keyboard is kept out of the water) to prevent staining. Other keytops will not be harmed.

Let the chassis soak about 10 minutes. Two or three times, grasp it with both hands and work it vigorously up and down. Clean the type faces with a fiber vegetable brush or an old toothbrush. Hold the keys down with the flat of a hand to lift the type bars, and brush their sides.

After 10 minutes the machine should be clean and degreased, but see whether any eraser crumbs still cling. If necessary, soak it slightly longer, let it drip, then drain off the detergent.

Rinse the machine thoroughly with hot water. A kitchen spray hose is ideal, or you can hold the chassis under a faucet with a spray attachment. Be sure to wash away all traces of detergent. Then remove as much water as possible by shaking the machine vigorously.

Now dry the machine thoroughly. On a warm, bright day you can put it in the sun. Indoors, put it in the kitchen oven at low heat. Be careful not to overheat plastic keytops. While the machine is drying, you can clean the feed rolls, the inside of the case and the paper guide with a cloth dampened in alcohol.

Check the platen, too. If its rubber covering is hard or pockmarked, have it resurfaced by a typewriter dealer or send it to a parts-supply house for this job. If the feed rolls show flat spots, they too should be renewed.

Provided the platen is not too rough or deeply pitted, you may be able to resurface it yourself. Wrap half a sheet of wet-or-dry abrasive-oxide paper, 240 grit, around one end of the cylinder. Wet the platen freely, hold it by the other end and work the abrasive paper back and forth with a circular motion. Reverse the platen to do the other end.

Dried with a towel, it should have a

Oil machine while it's still warm. Here's where:

1 **SPRING DRUM.** It's shown here with carriage strap in place.

2 **CARRIAGE RAILS.** Be sure to lubricate these sparingly.

3 **SUB-KEY ASSEMBLIES.** After oiling them, wipe off any excess.

4 **RIBBON-FEED RATCHET.** Another spot to oil sparingly.

5 **RIBBON-SPOOL MECHANISM.** Lubricate shaft bearings and gears.

6 **BACK PIVOTS** of sub-key assemblies. Again, oil lightly.

7 **UNDERSIDE OF CARRIAGE RAILS.** Slide carriage to spread oil.

8 **(DO NOT OIL** the type segment. Oil here will collect dust, make type bars work hard.)

smooth, dull surface. However, if the abrasive only tends to polish the platen, the rubber is too hard and should be replaced. A hard platen will let paper slip, fail to space evenly, and wear out ribbons quickly.

The time to lubricate is while the typewriter is still warm from drying. You can use any good household or sewing-machine oil; I have used No. 10 auto engine oil for years.

Caution: Do not oil the slots in the quadrant where the type bars are hinged. If the machine is clean and mechanically sound, they will move freely. Oil holds eraser grit and dirt in the slots, causing wear.

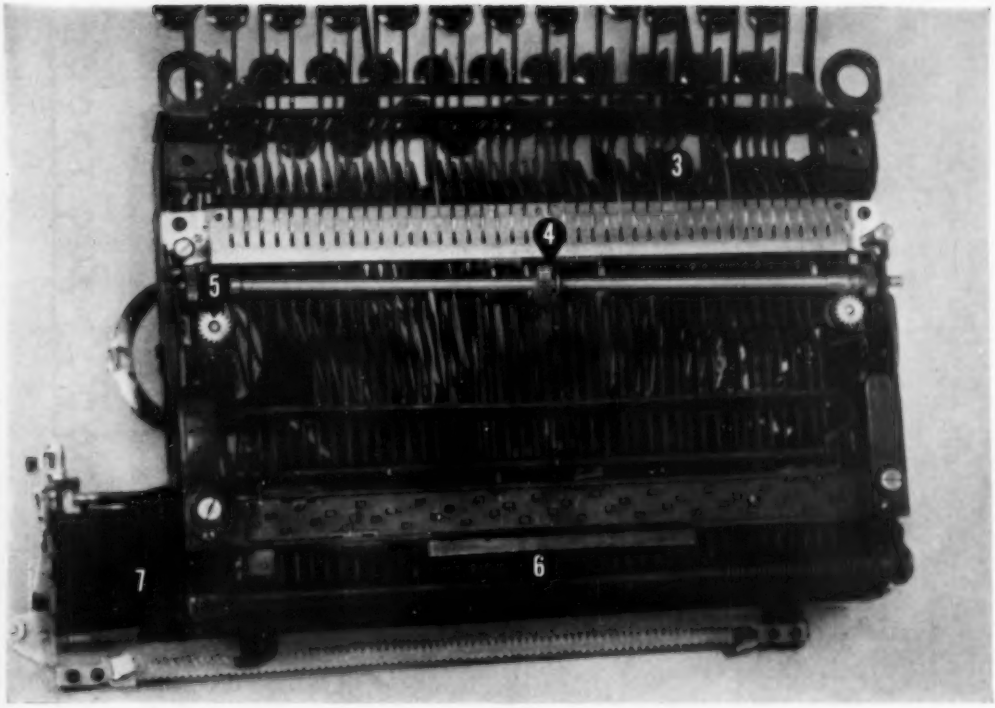
Be very sparing with oil, applying it only to moving parts. Follow the ribbon mechanism through to oil all bearings and rollers. Remember that *lightly* oiled is *rightly* oiled.

Start the reassembly by replacing the carriage strap, if you removed it. This drawband, if catgut or cotton, can be replaced with a nylon fishing leader. Attach one end to the right-hand end of the carriage. Draw the other under the carriage toward the spring drum.

Turn the drum clockwise until you just feel the spring take hold; then continue turning three full turns and attach the carriage strap. Fractional turns of spring adjustment can be made on most machines by loosening a lock screw on the back that lets the ratchet dog slip.

Place a drop of oil on each end of the feed-roll shaft. If the rolls turn independently, oil each sparingly, taking care to get no oil on the rubber.

Replace the paper guide and then the platen. If this does not readily enter at the left-hand end, try holding down the paper detent (the spring-mounted roller that engages the toothed wheel) with a screwdriver as you replace the shaft. Don't tighten the knobs too close to the end frames. As a test, the platen should now turn freely with the paper-release lever up and the line-space ratchet off.



How to check and adjust a typewriter's action

AFTER inserting paper, type the test sentence "the quick brown fox jumps over the lazy dog." This will show whether any keys stick in the type guide (the forked jaw in front of the ribbon). Any that do so have a bent bar. Push the type bar up into the guide and hold it there while straightening it with flat-nose pliers.

Now check the vertical travel of the carriage or type segment that lets you shift from lower case to capitals. Strike a small *h*, then a capital *H*, then another small *h*. Do the same with *k* and *l*. If the bottoms of these letters do not form a straight line, the travel needs adjustment.

On most machines this must be done on both right- and left-hand sides. Find the stop screws; there are two for lower-case and two for capital-letter alignment. See whether your small *h* is printing equally dark at top and bottom; if not, and the capital prints evenly, it's the lower-case adjustment that should be changed.

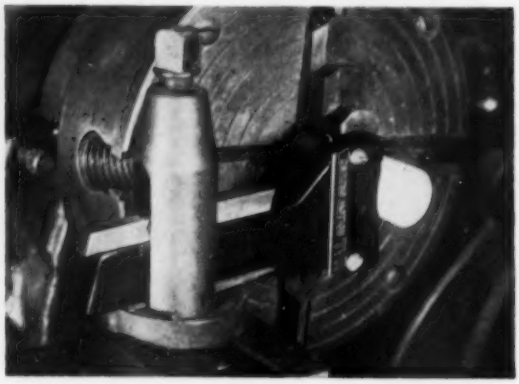
Moved slowly by hand, a type bar should trip the carriage space when about ⅜" from the platen. If it spaces too far away, the machine will type hard; if too close, it will shadow-print or double-space at times.

To adjust this, look under the carriage for the star wheel that is part of the escapement. The other part has a fixed and a loose dog, or pawl, which catch alternately in the star wheel, moving the carriage one letter space. Find which lever or rod works this part, and shorten or lengthen it to trip the escapement at the right moment. END

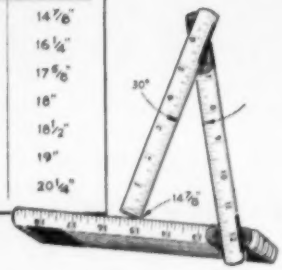
PS Shop Notebook

Plastic Cutoff

There's no waste or distortion of thin plastic stock if you use a single-edge razor blade to make cutoffs in your lathe. Shape a blade holder from steel, brass, or aluminum. Secure the blade with machine screws, as shown. Work close to the chuck, and ease the blade in slowly.—*Phil McCafferty, Stanwood, Iowa.*



ANGLE	POSITION
30°	14 7/8"
45°	16 1/4"
60°	17 5/8"
65°	18"
70°	18 1/2"
75°	19"
90°	20 1/4"

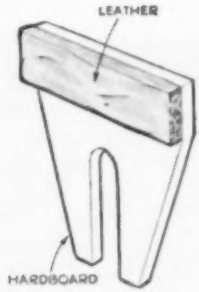


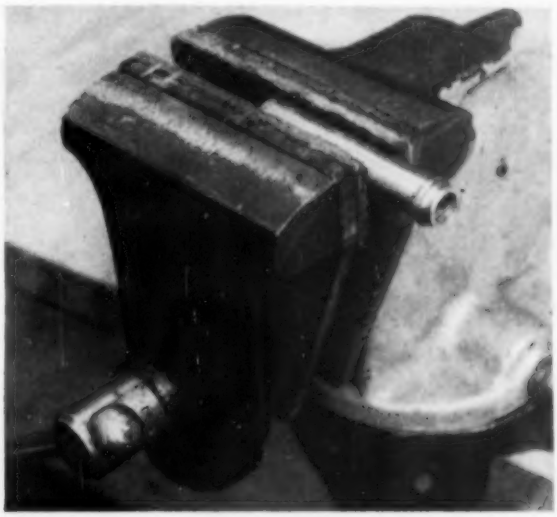
Rule Finds Angles

No protractor handy? It's still easy to lay out a number of common angles, using a chart like the one at the left and a 6′ folding rule. Partially open the rule at the 6″ and 12″ hinges to form a triangle. With the inside corner of the tip at 14⅞″, for example, you will get a 30° angle at the 6″ hinge.—*Walter D. North, Chicago.*

HAVE YOU TRIED THIS?

Use a strip of emery cloth folded over the end of a screwdriver and attached with a rubber band, to resharpen the lips and spurs of augur bits safely. The smooth sides of the "file" won't injure other parts.—*Ken Murray, Colon, Mich.*





Leather Jaws on Vise Protect Work

Finished surfaces won't be marred when you grip parts in a vise with leather-covered jaws. Cut two backing plates from hardboard, jigsawing recesses at their lower ends to hold them in alignment when they are slipped over the guide post and screw. Cement pieces of ⅛″-thick leather opposite the vise jaws.—*Robert V. Thompson, Clinton, Iowa.*

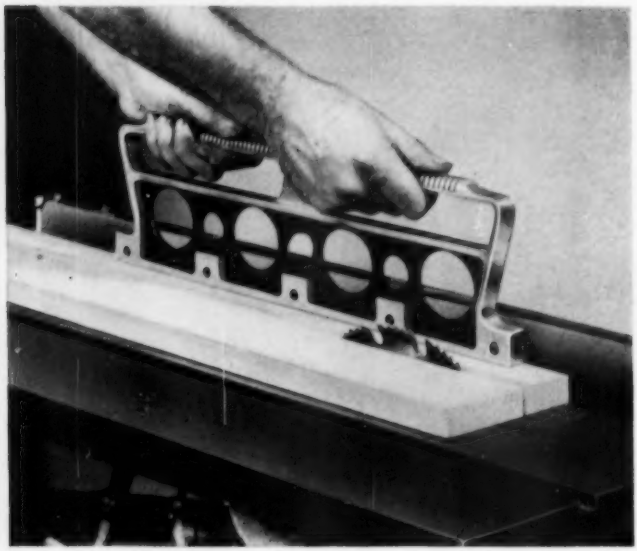
Handy Deburring Tool

A useful deburring tool can be made from a thermoplastic-handled screwdriver and a countersink. Heat the screwdriver in boiling water until its handle can be twisted off. Redrill the handle hole a bit smaller than the countersink shaft. Soften it again and drive the shank in.—*H. J. Gerber, Stillwater, Okla.*

Workbench Reflector

Reflected light from a square of shiny material shows up gaps from the rear when you check parts with a straightedge or try square. Make the reflector from an 8″-by-12″ rectangle of white-enameled steel or painted hardboard. A hole near one corner will let it hang within arm's reach.—*W. E. Burton, Akron.*

New Tools

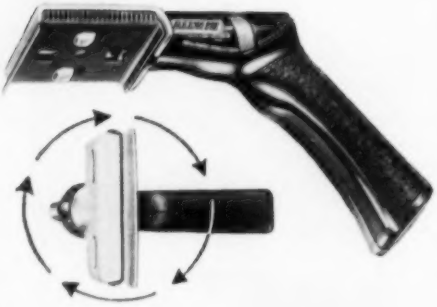


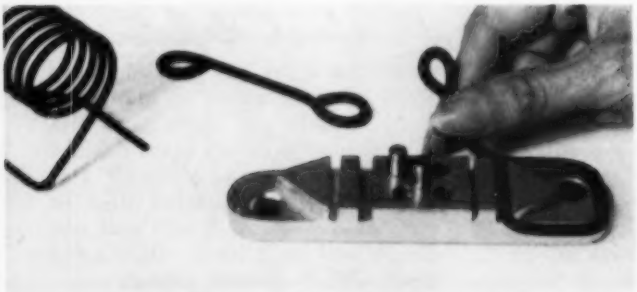
1. Pusher Has Grip. You use both hands to pass work safely over a table-saw blade or jointer cutters with this pusher stick.

Made of cast aluminum, it has five slots on its lower edge to take dual-prong clips that you can adjust to various depths of penetration for holding the work firmly. The clips may be reversed for extra use, and replacement points are available. They are said not to mar the work.

2. Pistol-Grip Scraper Has Pivot Blade. For taking off old paint on flat surfaces at any angle, and in hard-to-get-at spots, this scraper with a natural grip has a blade that you can rotate and lock in any of eight positions.

The blade, which is renewable, has four cutting edges, two of them corrugated for first-pass coarse scraping of paint that has flaked badly, and two finer ones for getting down to the wood. It is installed in the holder without tools.

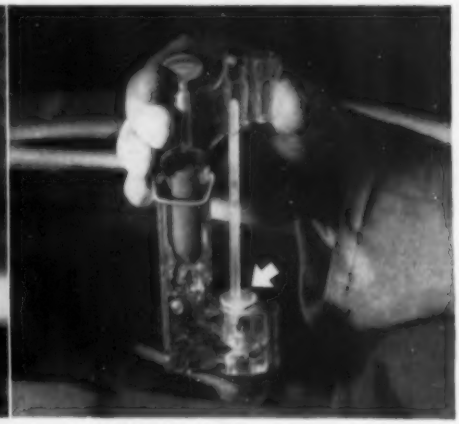




3. Jig Shapes Wire. Two movable studs and a series of slots act as brakes for bending wire on this new midget-size jig. Screwed down, the jig helps you bend eyes, spirals and various angles in even heavy wire.

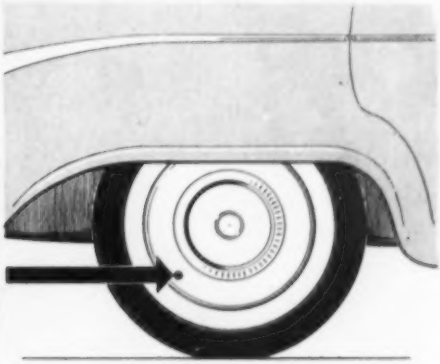
More information *about the products on this page can be obtained from: 1. Safety Research Corp., 811 E. State St., Sharon, Pa.; 2. Allway Mfg. Co., 1513 Olmstead Ave., Bronx 62, N.Y.; 3. Little Beaver Industries, 38845 Mentor Ave., Willoughby, Ohio.*

New for Your Car



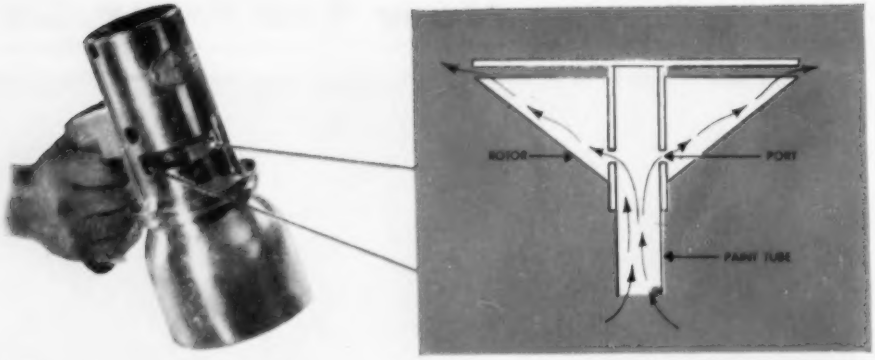
1. Tester Freezes Antifreeze. With this plastic "soda straw," a service-station attendant samples the antifreeze in your radiator, then freezes a cupful (arrow, right) with CO_2. A built-in thermometer registers the temperature at which the frozen slush melts, which is the danger point for freezing in the car. The method is said to be more accurate than measuring the specific gravity of the solution.

2. Wheel-Disk Lock. Threaded onto the tire valve stems, four of these little devices will protect your wheel disks from thieves. The flange diameter, larger than the valve hole in the disk, will keep the disk from being pulled off. Free-wheeling on a threaded center, it requires a special key for screwing on or off.



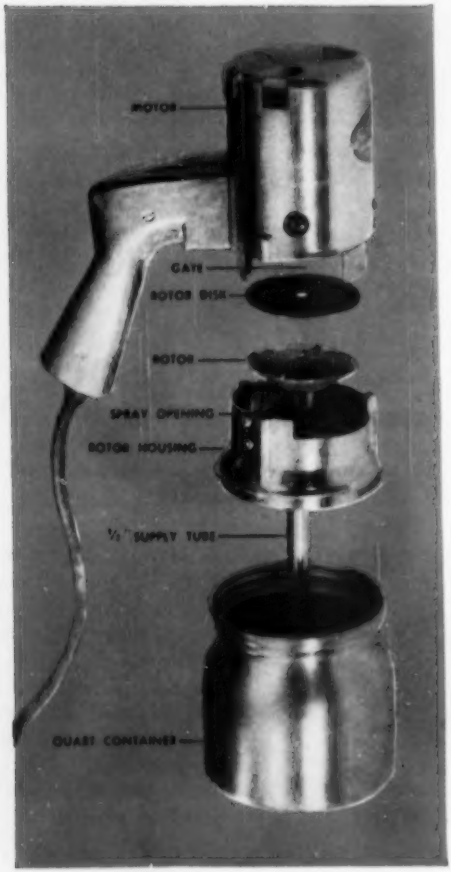
3. Midget Trailer. This 5′ trailer, for use with any car, is designed especially to hitch on a Volkswagen. It will hold 800 lb. and has an adjustable tongue for hauling a 12′ boat. A fitted tarpaulin and brackets are extras.

More information *about the products shown on this page can be obtained from: 1. Ralf Darbo, 200 N. Prospect Ave., Madison 5, Wis.; 2. Spencer Specialties, 3305 Wilshire Blvd., Los Angeles 5; 3. Grand Prix Motors & Mfg. Co., Big Rapids 8, Mich.*



New Gun Slings Out Paint

ROTOR THROWS PAINT. Vanes on rotor work like a vacuum-cleaner impeller, drawing paint up from can. Centrifugal force causes paint to flow to edge of rotor where it flies off as mist.



IT LOOKS like a spray gun and it paints like one, but the Rogers Rotary doesn't *spray* the paint—it slings it.

A vaned rotor driven by a three-speed motor creates light suction to draw paint up from the container. When the paint reaches the rotor, it is slung off the edge like water flying off a wet wheel.

To keep the paint from spinning out in all directions, three-fourths of the rotor is enclosed by a housing. The remaining opening can be narrowed by a sliding gate to adjust the paint pattern from a wide fan to a thin strip.

Paint flies off the spinning rotor in a horizontal plane, making it necessary to move the gun up and down instead of from side to side as with an air gun. The gun cannot be triggered off and on at the end of each pass; you have to keep it moving.

It is cleaned simply by whirling solvent through it with the gate shut.

Since the three-speed motor is not explosion-proof, the gun should not be used with lacquer or paints containing highly volatile thinners. Principally suited for water-thinned paints, the gun comes in an improved model said to be suitable for use with some oil paints.

Napco, Inc., 3473 Fairmount Blvd., Cleveland, Ohio, distributes the gun. It's listed at $39.50.

Sliding-Door Trick Gives Us More Space

By Paul Corey

ONE swinging door is bad enough when you get in its way. The pair leading from our kitchen to the sun porch used to be double trouble. Opened wide, they bumped into furniture. When they were partly open, we were the ones who got bumped. But all of this was before I worked my sliding-door trick.

Now, the doorway still is the same, and so are the doors. But with hinges

BEFORE

AFTER

PRECUT PLYWOOD PANEL covers framed pocket on each side of opening. This allows both glass doors to slide out of sight.

DOUBLE-ROLLER HANGERS are screwed down on top of door, one set near each corner. They will ride on track, carrying the door.

L-SHAPED TRACK is screwed to underside of a two-by-four nailed against old wall and into its studs. Track spans doorway, both pockets.

gone, they no longer push into the room. Hanging from a track, they slide away from each other into a snug pocket at each side, protruding from the pocket just enough to provide a handhold.

Mine are glassed doors, but you could convert solid ones exactly the same way. The track method answers other needs, too. For example, if you prefer a passageway where adjoining windows face a porch or terrace, cut away the wall beneath and hang glassed, sliding doors.

In any case, you need only enough wall space at each side of a doorway to give backing for the framed pockets that you build out from them.

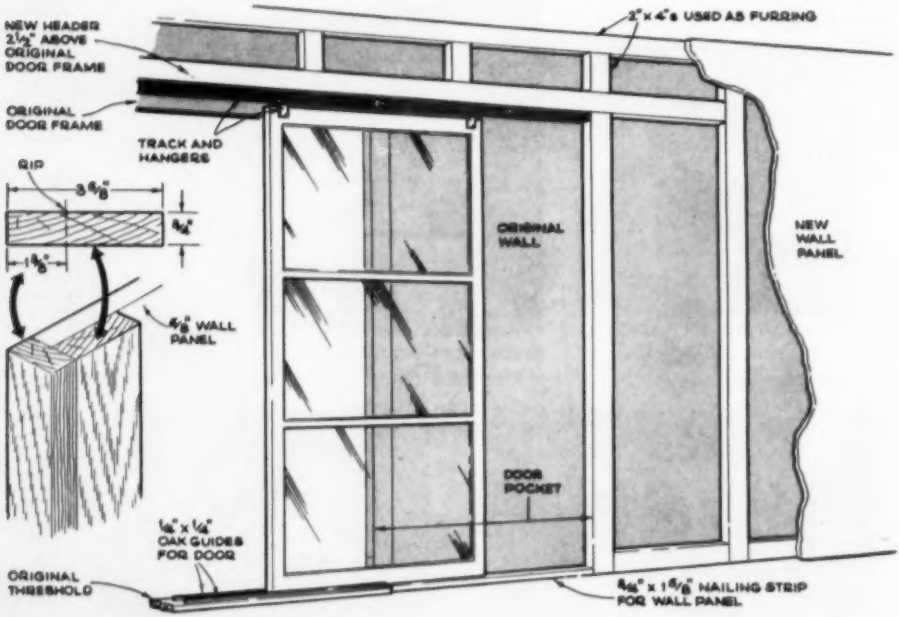
This method is easier carpentry than trying to slide a door inside an old wall. It does take away some room space, but not much—just the combined thicknesses of the header and whatever new paneling you use. For appearance, I continued furring along the rest of the old wall, then covered it with the same plywood used to face the pockets. For the paneling, I used large sheets of ⅝″ redwood plywood that were grooved every 4″.

The framework consists of two-by-fours nailed flat against the old studs. This provides 1⅝″ furring, allowing pockets roomy enough for most doors. (If your doors are over 1⅜″ thick, you may have to shim out the frame.)

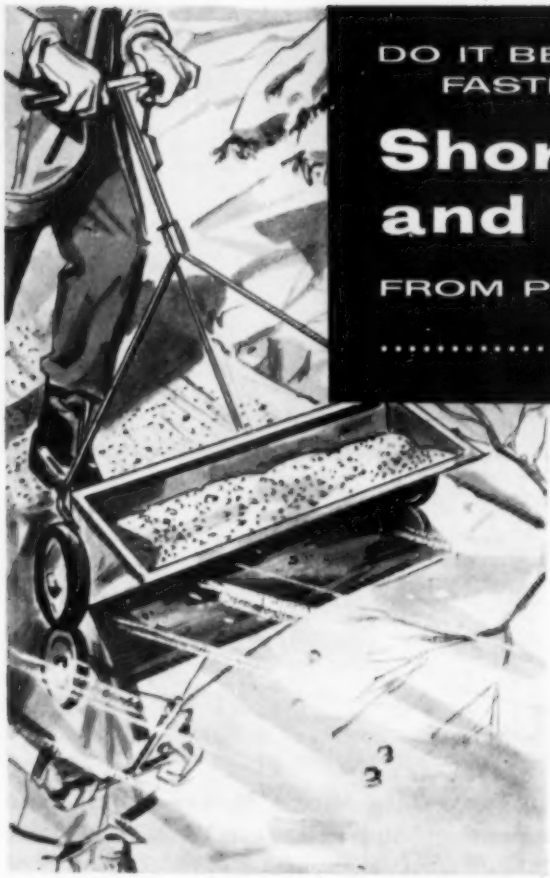
One of the framing pieces also served to hang the doors. This header was placed 2½″ over the tops of the doors to give ⅛″ clearance under them. The door track was fastened to the under surface of this header.

Two wood strips formed a channel to guide the doors over the threshold, and other strips were used to fasten the pocket panels at their bottom edges and brace their fronts.

At the top of each door I fastened a pair of hangers. Then I suspended both doors on the track and adjusted the hangers until they were plumb and moved freely. The track itself was simply screwed in place. END



FRAMING FOR ONE SLIDING DOOR was built this way, and duplicated for the other door. Beyond the pocket, the framing continues as furring over the old wall to build out a new wall flush with the pocket. Because the panel can be nailed into place only at top and bottom where it covers the pocket (the door has to slide behind it) it must be held another way. This can be done by gluing and nailing strips from a ripped board to the panel edge.



DO IT BETTER, FASTER, EASIER...

Short Cuts and Tips

FROM PS READERS

Lawn Spreader Takes Skid Out of Icy Walks

I PUT sand or a mixture of salt and sand in a lawn-fertilizer spreader and run it over icy sidewalks and driveways in wintry weather. Sand reduces the chance of dangerous falls; salt hastens melting of the ice.

The cart spreads a small amount evenly and quickly over the icy area with little effort on my part.—*Jon Snowman, Glen Ridge, N. J.*

Magnet Cleans Rubbed Surface

STEEL wool used to rub down a wood surface leaves particles that interfere with a smooth finish. Remove the particles by passing a small magnet over the surface. —*Ken Murray, Colon, Mich.*

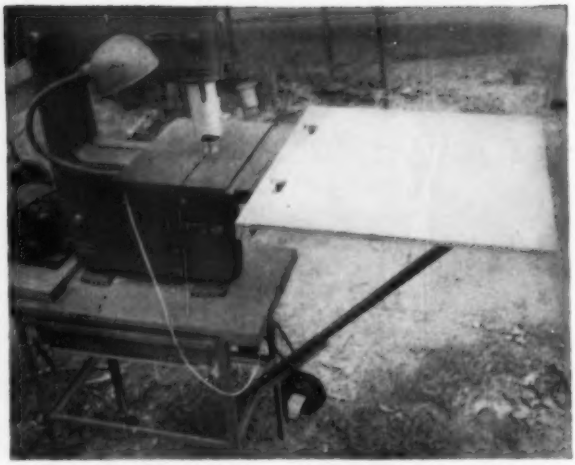
It Guards Soldering-Iron Cord

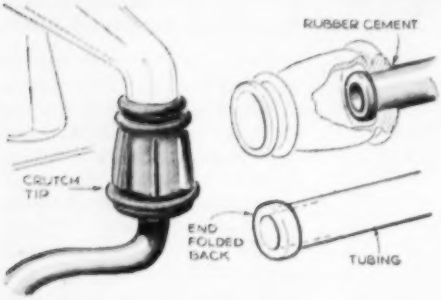
AN INEXPENSIVE non-kink cover designed for use on an electric-iron cord will also prolong the life of a soldering-iron cord and make it handier to use.—*C. C. Cooley, New Buffalo, Mich.*

Short Cuts and Tips

Scrap Plywood Sheet Extends Saw Table

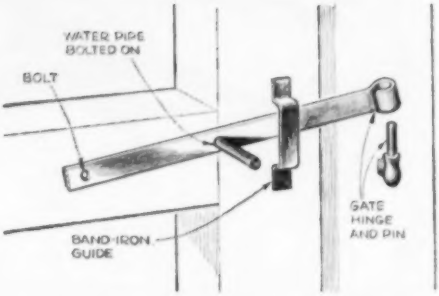
A PIECE of ¾″ plywood on my bandsaw table takes large work. I drilled and tapped two cap-screw holes in the table edge, put the screws through a cleat on the plywood, and braced the outer end.—*C. T. Pearson, Ypsilanti, Mich.*





Crutch Tip Hitches Hose to Tap

TO CONNECT tubing to an unthreaded faucet, try using a rubber crutch tip as a coupling. Cut a hole in the bottom, push the tube through, and fold it back at the end. Then draw back the tubing until this "collar" rests on the rim of the opening. Rubber cement will secure it. —*L. H. Victor, Albany, N. Y.*

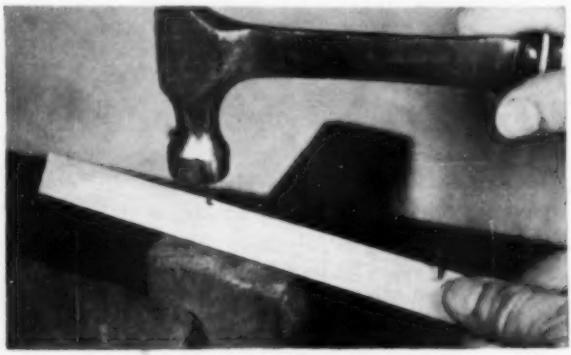


Gate Hinge Makes Latch, Too

AN ORDINARY gate hinge and pin make a good latch for a garden gate. A short piece of pipe bolted to the long hinge strap provides a handle with which you can lift the latch, and a length of band iron, bent as in the drawing and screwed to the gate stile, forms a guide for the bar.—*Victor H. Lamoy, Upper Jay, N. Y.*

Wooden Block Helps Salvage Molding

QUARTER-ROUND, base-shoe and other molding that was fastened originally with nails driven in with a nail set can be re-used with a little care. Wood around the nailheads will not splinter if you support the strip firmly on a wooden block as you pound the nails out.—*Phil McCafferty, Stanwood, Iowa.*



Tubeless Tires *can* be safely repaired

IF *. . . your tire repairman has proper equipment and materials*

Many car owners have had "sad" experiences with tubeless tire repairs. This has been true because the repairman did not recognize that you cannot use old methods and materials for tubeless tire repairing. It just can't be done that way.

Remember, it's the tire that has to hold air now . . . not the tube and this means that new methods and materials had to be developed.

For SURE, SAFE Tubeless Tire Repairing

look for the

BOWES *Tubeless Tire Repair Expert*

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Everything you need to

PROCESS COLOR SLIDES

exposed on Kodak Ektachrome Film

Think of it—in *less than two hours* after you click the last shot on a roll of No. 135 Kodak Ektachrome Film, your full-color transparencies can be completely processed. And as soon as the film is dry, it takes only a few seconds to mount each sparkling frame for *immediate* viewing!

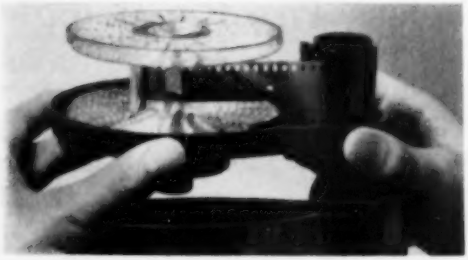
Everything you need—equipment, supplies, step-by-step instructions—are included in the new Kodak Ektachrome Processing Outfit, 35mm. Since you work in normal roomlight, you can process color slides anywhere—even on a vacation trip. The chemicals in the outfit will process six 20-exposure rolls of No. 135 Kodak Ektachrome Film (either Daylight Type or Type F). Complete replacement of these chemicals costs only $1.80.

NO DARKROOM REQUIRED

Ask your Kodak dealer to show you how easy it is to process Ektachrome transparencies. And don't forget . . . he also has Kodak Photo-Hobby Outfits for developing and printing black-and-white snapshots. These kits also contain *everything* needed—and are so easy to use your whole family will enjoy them. *Kodak Photo-Hobby Outfits*, from $9.95.

KODAK EKTACHROME PROCESSING OUTFIT, 35mm **$26.50**

These are the four basic steps in processing-

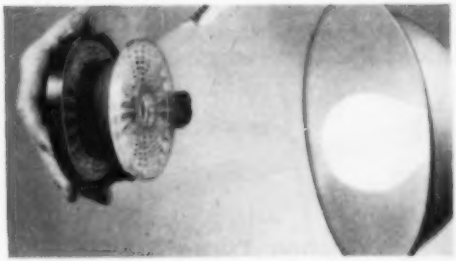


KODAK DAY-LOAD TANK simplifies transfer of exposed film from the film magazine to a transparent reel. Reel and magazine fit into separate tank compartments. With light-tight tank cover in place, loading the film onto the tank reel takes place by simply turning a knob. It's all done in normal roomlight!

ONLY 6 CHEMICALS, interspersed with plain water baths, are needed to bring out the gorgeous colors in Kodak Ektachrome Film. Each chemical is stored in its own color-coded container. With the empty film cartridge removed, liquids are poured in and out of the developing tank in full roomlight as shown:

EASTMAN KODAK COMPANY,

mounting Ektachrome transparencies . . .



RE-EXPOSING the color film (to reverse the images from negative to positive) takes only 60 seconds. No need to touch the film with the fingers because light reaches all portions of it through slots in the tank reel. After re-exposure, film receives final processing baths.

FULLY DEVELOPED film is dried in the usual way. Individual frames are cut to size with trimming guides, then inserted in cardboard mounts provided. Edges of each mount are sealed with a warm iron.

Rochester 4, N. Y.

Prices include Federal Tax where applicable and are subject to change without notice.

Kodak
TRADE MARK

Short Cuts and Tips

Push Toy Amuses Youngster

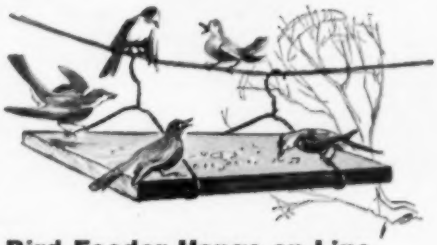
AN EMPTY adhesive-tape case makes a good push toy. Saw a wooden spool in two and wedge the halves into the "wheel" for a hub. Anchor them with cement, or wrap with tape to give a tight fit. I robbed a fly swatter for a handle; but a wire coat hanger can be bent to do the same job.—*Fred Cornelius, El Paso, Tex.*

Decals Dress Up Doorknobs

LIKE those fancy china doorknobs that look so pretty but cost so much? You can make them without much trouble. Buy a can of refrigerator enamel and some decals. Paint the doorknobs, let dry and apply your decal. Your home-made knobs, if you do them carefully, will be hard to tell from the costlier china ones. —*Frank A. Javor, Newark, N. J.*

Scriber Has Retractable Point

FOR a scriber safe to carry in your pocket, use a phonograph needle and an old ball-point pen of the retractable kind. Remove the pen's empty cartridge, pull out its writing tip with pliers, and solder the needle in its place. Result: a clip-on scriber with a sharp, hard point that retracts out of pricking range.



Bird Feeder Hangs on Line

TO MOUNT a bird feeder so it would be inaccessible to cats, I designed one that hangs from the clothesline: a board with a raised molding rim on all four sides. It is grooved on the underside to fit two wire coat hangers that support it.—*Alexander Walker, Canon City, Colo.*

Wrench Turns Bit in a Tight Spot

IN CLOSE quarters it may be awkward and sometimes impossible to bore a hole with a brace and bit. In such cases, I turn the bit with a box-end wrench slipped over the shank end like this.—*Hugh Lineback, Stillwater, Okla.*

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Short Cuts and Tips

Arm Extender Helps You Carry Wallboard

It's a lot less awkard for one man to carry a panel of plywood or plasterboard, if he has a wooden lifter like this hooked under one edge. Its handle, a piece of one-by-two, is nailed to the 1″ side of a 10″-long cleat of the same stock. A matching piece nailed to the other narrow side of the cleat forms a 1″ lip to hold the board steady.—*R. Mathiot, Lake Grove, Ore.*

Tapered Enclosure Saves Space

THE tiniest bathroom can be dressed up with a sink enclosure if you taper the sides. Three pieces of 1/4″ plywood, two of them triangular, and four 3/4″-by-1″ wood strips make it. Two strips nailed to the wall mount the sidepieces. The others are nailed along the long edge of each triangle. The front panel is screwed to these for easy access to the plumbing. —*Darrell Huff, Sonoma, Calif.*

Box Jig Cuts Drilling Time

WHEN I had to drill several dozen identical parts for screws, this jig speeded up the work. An open-end box made to hold three stacked parts, it has a galvanized top with guide holes for the drill. The same drilling-by-the-batch idea will work on many metal parts, too. —*H. G. Rich, Milwaukee, Wis.*

▶▶▶ALLIGATOR clips are more dependable than your memory when you're wiring a hi-fi kit. Clamp the clips to the terminals to be connected and you won't forget where they are while you're cutting leads to length. Use color-coded clips to index several pairs of terminals at once.—*Rocco M. DeFina, Brooklyn, N. Y.*

GM GENERAL MOTORS

GUIDE

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WIDE WIDE WORLD
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Presents a BIG Difference in Headlamps

Extra 3-Step Electronic Check Builds in Industry's Most Accurate Safety-Aiming!

1 Special machine accurately locates center of light beam for every Guide T-3 Headlamp that comes down the line. Once this "center" is found, lamp is locked in place . . .

2 . . . electronic brain measures height of each "Guide Point" and automatically computes amount of grinding necessary. This information is then stored and passed along . . .

3 . . . automatic grinder takes "Guide Points" down to proper height with gem-like precision. When grinding is complete, lamps can then be aimed with amazing precision.

YOU GAIN because perfect aim is a must these days when new industry-approved advances build greater power and a new, more efficient pattern into most headlamps. However, to get the benefits of this increased power (10% more light on the high beam) and improved pattern (80 feet more "seeing distance" on the right for "low-beam" driving) headlamps *must be perfectly aimed*. This means lamps must be within a fraction of a degree for horizontal aim, and must be held to even closer tolerances in the vertical plane.

That is the whole point and purpose of the gem-ground "Guide Points" on the face of every Guide T-3 Headlamp.

Perfect aim in minutes, in daylight! And, only Guide can guarantee it! They're standard equipment on all General Motors cars and trucks. See your nearby authorized Guide dealer now.

Buy in pairs where you see

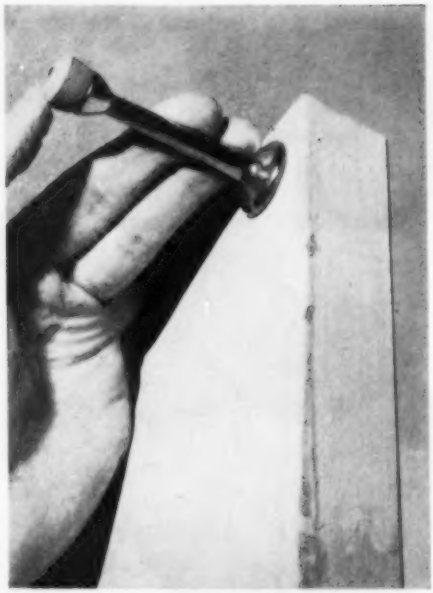
AC

AC SPARK PLUG THE ELECTRONICS DIVISION OF GENERAL MOTORS

Short Cuts and Tips

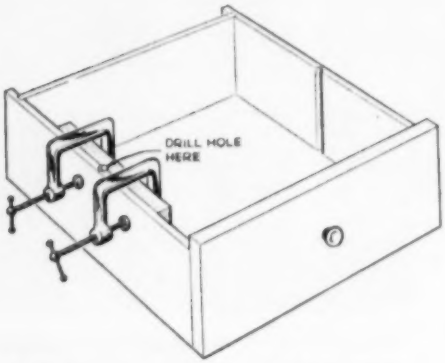
Pattern Guides Glass Cutter

To CUT glass for a perfect fit, first draw on paper a pattern of the shape you need. Placed under the glass, it will show where to cut. On all straight lines, use a steel rule to guide the cutter accurately. —*Leslie E. Schultz, Cicero, Ill.*



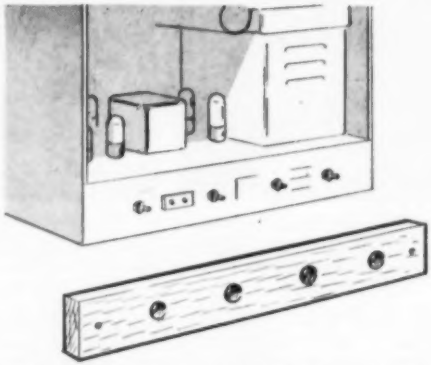
Space Saver: Doorstop on Door

IN CRAMPED quarters where a baseboard doorstop sticks out into the line of traffic, or in a modern home without baseboards, a good place to install the fixture is at the upper corner of the door. —*Frank A. Javor, Newark, N. J.*



Drill Cuts Partition Grooves

To CUT grooves for partitions in a shallow wooden drawer, I clamped a board at one side, matching the run of the grain. Then I center-punched a hole where drawer and board met and drilled to the bottom. After grooving the opposite side, I sanded the edges of the partition and slipped it in.—*C. A. Lange, Topeka.*



Wood Block Covers TV Controls

IF YOU plan to move your TV set to a new house, or take it out for repairs, protect its controls against being knocked out of adjustment. The shafts on some sets extend from the back. For these, make a cover of one-by-two stock drilled to receive them, and screw it to the back panel.—*Frank LaSaracina, NYC.*

SENSATIONAL SPRING OFFER SAVES YOU $14.00

Famous Porter-Cable Model 136

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Total value 78.45

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Get *two* quality Porter-Cable tools for a *special* low price of *one!* Buy Porter-Cable's popular 3" Belt Sander at a special low price of $64.45 and get a FREE Bench Stand with miter gauge, worth $8.95! You save $14.00 on both tools!

You'll want both of these quality Porter-Cable tools for doing all kinds of sanding jobs easier . . . faster . . . more professionally than ever! Don't pass up this terrific double value! See the yellow pages of the telephone book for name of your nearest Porter-Cable dealer—or use coupon for complete information. (Offer expires March 31, 1957.)

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Please send complete information on the special Spring offer that saves me $14.00 on the Model 136 3" Belt Sander and Bench Stand.

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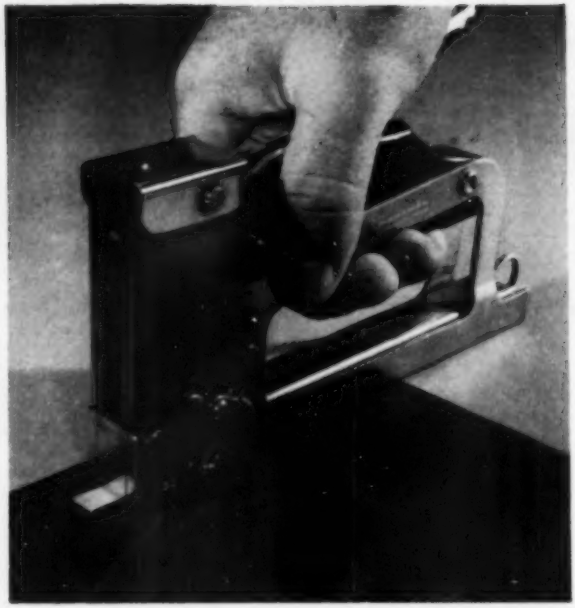
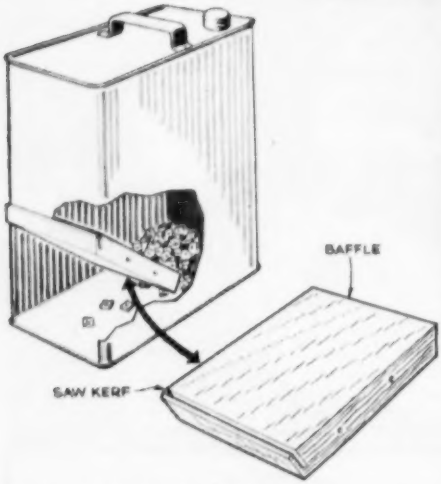
Short Cuts and Tips

Strip Lifts Staples

HERE'S how to keep from whamming staples too deep for easy removal when you only want to fasten work temporarily.

Slide a thin strip of cardboard, narrower than the staple's span, under the tacker's nose before squeezing its lever. When the strips are pulled out, a screwdriver tip can be run under the raised staples to lift them without gouging the surface.



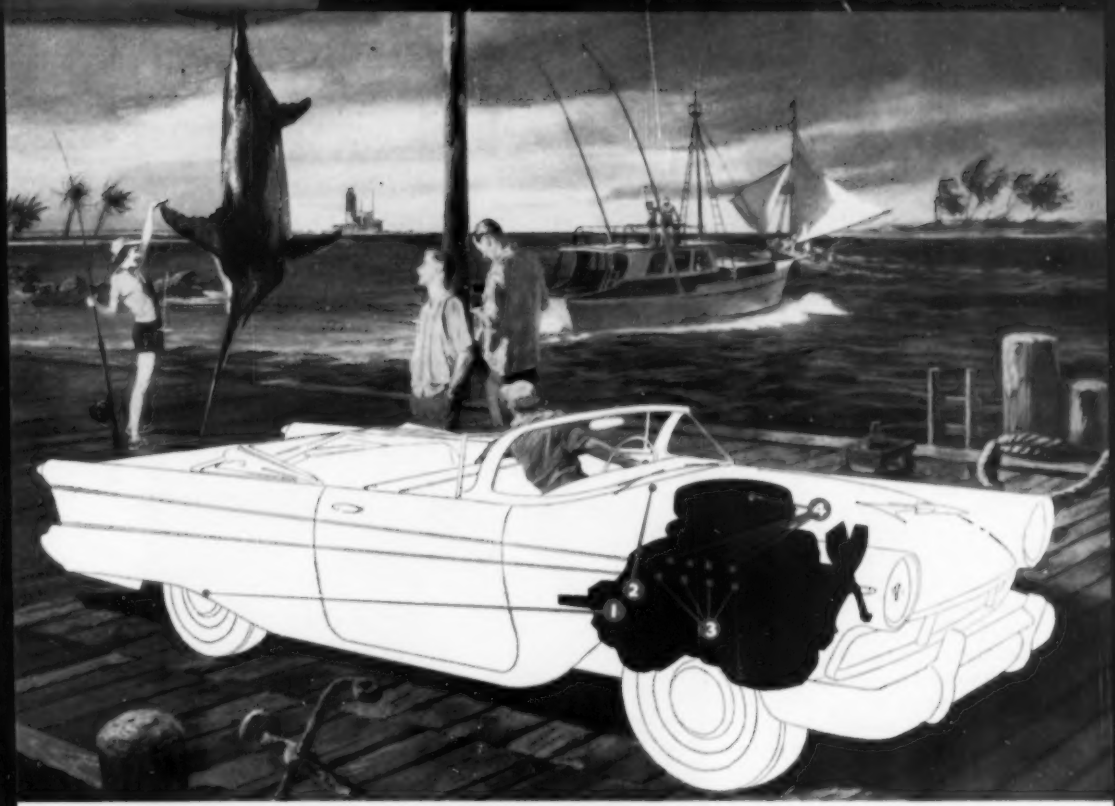


Parts Bin Is Self-Feeding

YOU can turn an empty gallon can into a self-feeding dispenser for small parts. Snip an opening in a narrow side, starting at bottom and running a third of the way up. Then fit in a wood baffle, notched with a saw kerf. The kerf positions the baffle so that you can fasten it to the sides with wood screws. To fill the can, drop parts in through the same opening.—*Charles Willey, Concord, N.H.*

Barbecue Is Shaped Like a Well

I WANTED something different in barbecues, so I made mine like an old-fashioned well. Built of brick and cement, it has an opening on one side for a firebox that can be raised and lowered on a scissor jack. The windlass and oaken bucket are removable decorations.—*Charles Wimberly, Talbotton, Ga.*

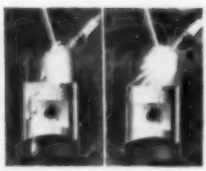


1 More road horsepower—If you haven't changed your spark plugs recently, new 5-rib Champions can give you an *immediate* increase in road horsepower—the actual power delivered at your rear wheels. Independent tests prove most cars get an increase of 6% to 31%—for better hill climb and *safer passing!* No wonder 9 out of 10 racing drivers—men who really know cars—insist on Champions!

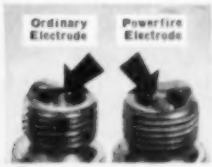
If you haven't changed your plugs in about 10,000 miles—

You can make your car 4 ways newer with Champion spark plugs!

2 Quicker starts—New 5-rib Champions cut starting time 39% on the average—in tests with cars whose regular plugs had gone 10,000 miles or so. New Champions will give *you* quicker starts . . . save battery wear.



3 Less engine wear—When old plugs misfire (left), raw gasoline drains into the crankcase . . . dilutes engine oil. New full-firing Champions (right) in your car will protect oil from dilution . . . help you avoid costly repairs.



4 Lower cost-per-mile—Champion's great new Powerfire electrode stands up better than ordinary types under identical use . . . gives top power and gas economy for life of plug. Always insist on Champion Spark Plugs!

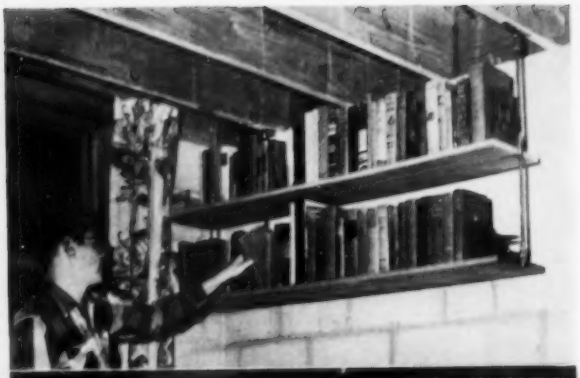
Short Cuts and Tips

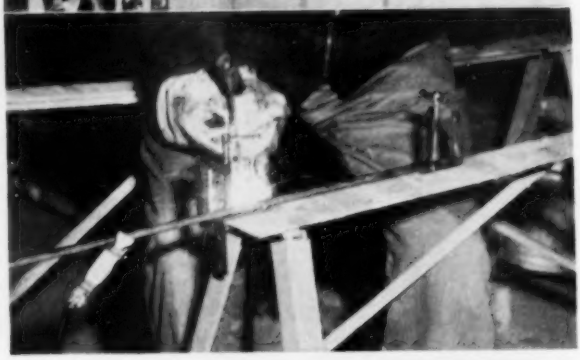
Storage Shelves Hang from Rods

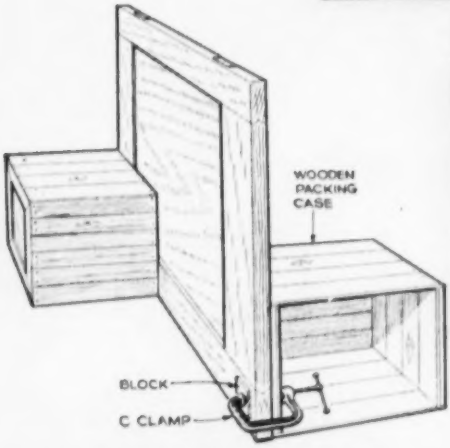
SHELVES hanging from the joists in a basement recreation room, shop or laundry will give you extra space for storage.

The hanging bookcase shown at right is supported by three solid-steel curtain rods: one at the open end and two, front and back, near the corner. Angle brackets are welded at top, bottom and midway on each rod (lower right).

Screw 1"-by-10" boards to the brackets.—*Walter Rudolph, Fairview, Pa.*







Boxes Hold Door for Planing

A TRICK that I once saw a carpenter using could be put to use by a homeowner who is faced with the job of planing the edge of a door to cure sticking.

To hold the door after removal from its hinges, clamp a wooden packing crate to each end on opposite sides as above. —*Victor H. Lamoy, Upper Jay, N. Y.*

Tubing Holds Cutting Blade

A PIECE of metal tubing slotted at one end makes a good handle for a razor blade. Slide the blade in the slot and secure it by flattening the tube tightly around it with pliers. A strip of tin-can stock bent along its length can be crimped to grip the blade in the same way.—*T. F. Zimmerman, Beverly, N. J.*

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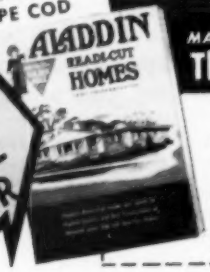

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By hitching five rotary lawn mowers to the front of a tractor, Albert Bachand of Williamstown, Mass., got a gang mower for $500—about half the cost of a big commercial machine.

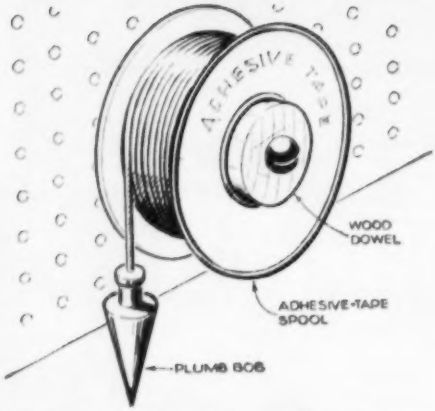
The mowers are the push type—the gasoline motor drives only the blade, not the wheels. Each one-lunger must be started individually. Together, they cut a swath 7′ wide.

Because the pivoting point of the rigging is out in front, it swings wide, as at lower right, when the steering wheel is turned to cut corners or maneuver around trees or shrubbery.

Mirror Directs Flash Beam

When it's difficult to position a flashlight so the beam is directed where you want it, try this trick:

Attach a pocket mirror to a strap hinge with cement or a rubber band. Use another band to attach the hinge to the flashlight. Swing the hinge to aim the light beam.—*Ken Murray, Colon, Mich.*



Tape Spool Holds a Plumb Line

You can hang a plumb bob on a tool board if you wind the string around an adhesive-tape spool. Plug the center hole with a snug-fitting dowel and mount it with a wood screw if the tool board is made of plywood or solid wood. Use a machine screw and an adapter if it's perforated hardboard.

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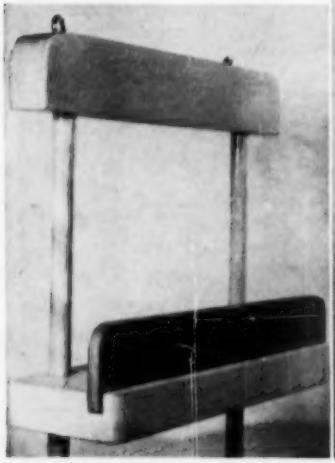

Paint Protects Bound Rope End

WHEN you whip a rope to prevent fraying or to form an eye, finish by painting. It protects the whipping from abrasion. Use a bright easy-to-see color.—*C. C. Cooley, New Buffalo, Mich.*

T Hinge Serves as Gate Lock

NEED a simple gate lock? Cut a section out of the bar of a T hinge and screw the strap to the gate post. A cleat supports the bar when it's swung down to latch.—*Jean Lyon, Cedar Rapids, Iowa.*

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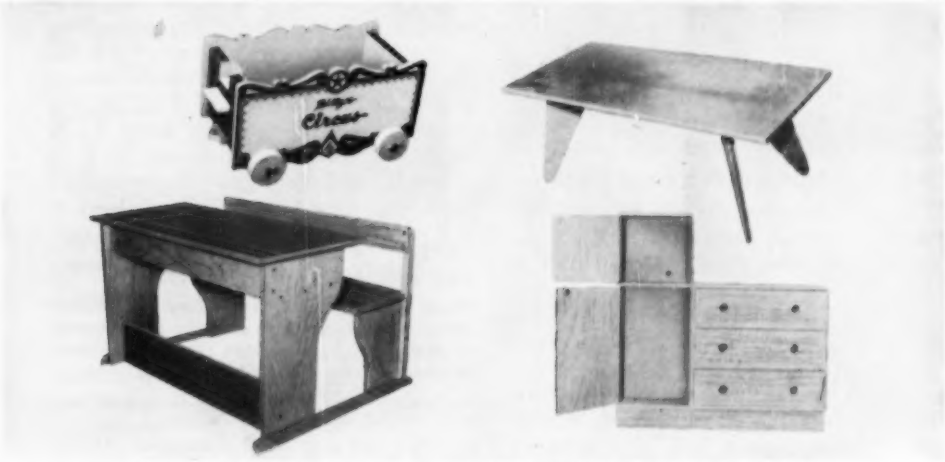

Upper left: 14" long circus wagon; **upper right:** 40" long rectangular coffee table; **lower left:** play-school bench; **lower right:** 53" high wardrobe-chest of drawers.

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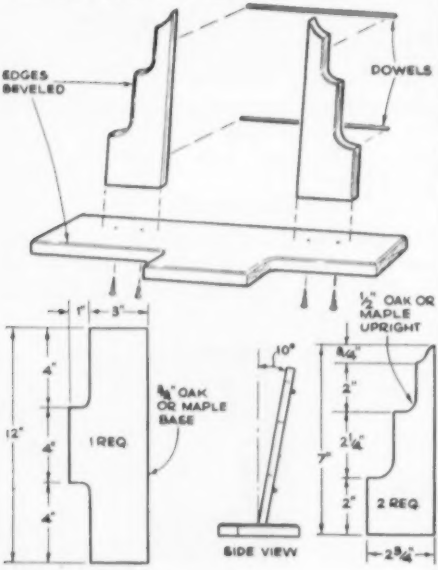
LOOK FOR THIS LABEL!

Easel Displays Framed Photo

A SINGLE evening is all the time you need to make an easel-type display stand for one of your framed family photos. The one shown takes a 5″-by-7″ frame.

Cut the base from ¾″ hardwood, the uprights from ½″. Bevel the bottom edges of the uprights to tilt backward.

In assembling the parts, space the two uprights just far enough apart so that the framed picture will slip between them. Glue and brad two ¼″ dowels to the back surfaces of the uprights. After applying the desired finish to the wood, cement a piece of felt to the base.



His Cartoons Save Pilots' Lives

[Continued from page 159]

began displaying his artistic talents not long after he cut his first teeth back in Minneapolis, where he was born the son of a sheet-metal worker.

"I've sketched from the time I can first remember," he says. "I went to South High School in Minneapolis and then to Minneapolis Art Institute on a scholarship."

Steve also won numerous awards for his illustrations in his high-school newspaper. By the time he was 19, he was working as a commercial artist for a small company in Minneapolis.

It was just before Pearl Harbor, when he figured that the draft was about to get him anyway, that Steve joined the old Army Air Corps. He spent most of the war in the Aleutians, as a crew chief and flight-line mechanic. There he became the expert airplane artist that he is.

"I literally tore airplanes apart and pasted them together again," Steve recalls. "I learned what really makes them tick." He has never learned to fly a plane, though.

At the close of World War II, Steve became a civilian again, but re-enlisted in 1947 after frustrating attempts to get back into commercial art. It was his good luck—and the Air Force's—that he was soon given the "Rex Riley" strip to do.

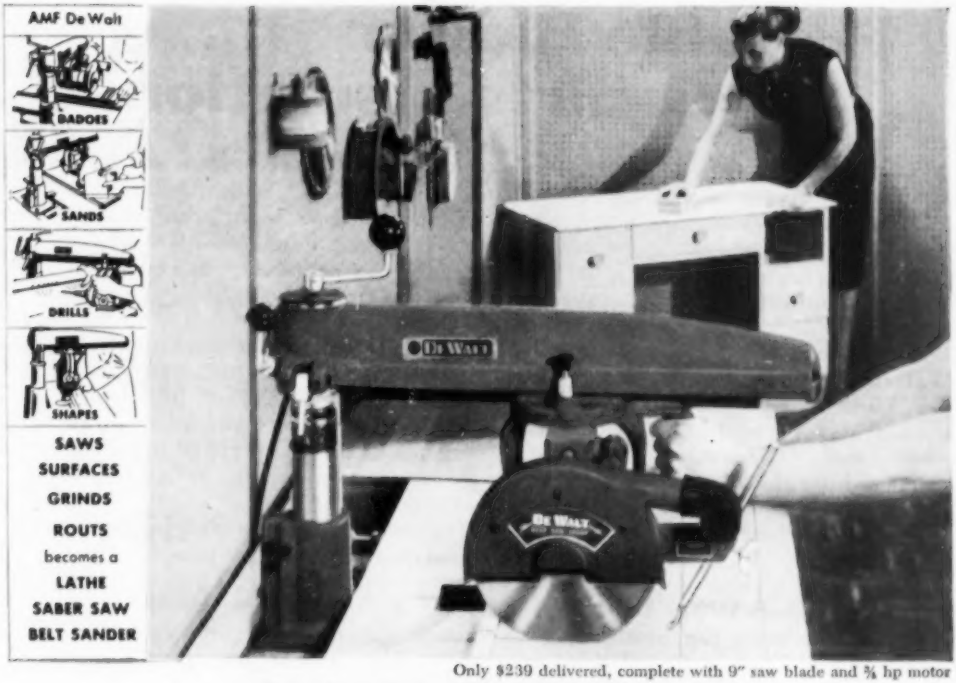
Fan mail pours in for Riley in a steady stream. Many of the letters Steve receives ask, "When are you going to promote him?"

Well, for those who believe Rex deserves more recognition, here's good news: Steve hopes to promote him to lieutenant colonel soon, if the Air Force brass will let him.

Steve Hotch, of course, will remain a master sergeant. END

NEXT MONTH . . .

Drop bombs UP? Here's how Air Force pilots in low-altitude attacks toss bombs so that they can escape from their own nuclear blasts. It's in March PS.



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Portable Blower Squirts Insulation

BLOWING insulation into a house used to take a crew of experts with a truckload of expensive machinery. Not any more. Now there's a pint-size, portable machine that will let you blow insulation into hard-to-reach spots yourself.

The baby blower is the invention of William H. Ross, whose company makes big blowers for professionals. Ross wanted a little one that a homeowner could handle. The result is a one-lung, gasoline-driven blower not much bigger than a power mower. Its 3.6-hp. engine starts and handles like a mower engine, too, yet will spray a stream of insulation through a 2″ hose up to 150′ long.

You won't have to buy the blower. The Ross Insulating Equipment Co. of Hayward, Calif., plans to sell them to lumberyards and insulation dealers. The machines will then be rented out for a few dollars a day. With a helper, you can tote one home in the trunk of your car, completely insulate a 1,200-square-foot attic to a depth of 4″ in a couple of hours, and return the machine the same day.

The hose will squirt insulation into the far corners of an attic, under eaves that are hard to reach and in between ceiling joists. Under floors, where loose insulation is the only type that can be used, you can remove one or two boards and blow it in.

The same machine can also be used to insulate walls the way the pros do. They remove strips of siding all around the house, and drill holes for the hose through the sheathing into each stud space. The blower will handle any "blow-type" insulation.

MIDGET BLOWER needs only one person to feed loose insulation into the hopper, while a second person mans hose in attic. Above, stream of insulation quickly fills spaces between joists, sprays far enough to reach into inaccessible corners. Blower weighs 160 pounds, is only 30″ long. The hose can be connected in 50′ sections to reach 150′.

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The Magna 9-in. Saw is the only tilt arbor saw with "The Helping Hand"—a built-in extension which makes the largest (34" x 24") effective table on the market—gives you bigger rip and cross-cut capacity than even 10-in. saws! Check these important features: Epicyclic Speed-gear Control gives you full 45° tilt with only 10 turns of knob (40 to 60 turns on other saws!) • Single-knob Control—push for blade height, pull for tilt • Self-aligning Fence locks both front and back with single knob • Externally adjustable Tilt Stops, easy to reach • Colored Safety Zone Table Insert cannot catch work piece • Exclusive pressure-cast tub front bolted rigidly to table, coordinates all controls • 3 Auto-stops on Miter Gauge • Inter-change Arbor for quick change of blades • Constant belt tension at any degree of tilt • Easily converted to largest capacity saw-jointer (operates at any height of blade) with Magna 4-in. Jointer and the inexpensive Magna Saw-Jointer Adaptor Kit!

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Our Push-Button A-Bomb Is Ready

[*Continued from page 103*]

"You hear some funny things at times," he said amiably. "But if you're trying to pry our Circular Error out of me, you're wasting your time."

"I don't want figures," I said. "But I'd like to know if this bird is good enough to hit an airfield. Or are you going to send it over loose, as a terror weapon, like the old V-1s and V-2s?"

Wright had a ready answer for that. "We certainly do not expect to use the Matador as a terror weapon," he said. "We are not in the terror business and never will be. I hope we never have to use the Matador at all—but if we do, we will use it against military targets."

"Like airfields?"

Wright grinned. "Okay—like airfields. And I can say this much about the Circular Error. I wouldn't want to be around a Russian jet strip when one of these birds was inbound."

The war plan of the Matador is simple. The 701st Tactical Missile Wing (first in the U.S. Air Force) is headquartered at Sembach, Germany. It is made up of three Tactical Missile Groups—the 585th, 586th and 587th. Each group has its own support squadron and its own communications and guidance squadron. Hundreds of Matadors are now distributed widely through the Eifel Mountains. More are coming in steadily as the program expands in depth toward the rear, toward France. The range of this bird is classified, but it can be "handed along" from one ground site to another and has enough JP-4 jet fuel for a very long flight indeed. Draw your own conclusions.

Morris and I saw a number of prepared "launching pads"—hard, flat, gravel-covered areas that are used for practice. The Russians undoubtedly know where these practice pads are, but theoretically this will not help them because we would not fire the Matadors from the practice pads in the event of actual war. They would be sent quickly by truck to wild wooded spots like the one Morris

[*Continued on page 250*]

MODEL 149B. *¼-inch drill; AC-DC 25 to 60-cycle; 115 volts; 2500 rpm. free speed; 1500 rpm. load speed; 3lbs.; U.L. approved.*

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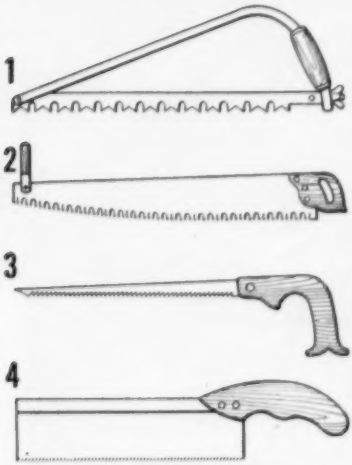
Nicholson Saw Quiz

How many of these saws do you know?



Answers: 1. Pruning Saw. 2. One-Man Crosscut Saw. 3. Keyhole Saw. 4. Dovetail Saw.

EVERY craftsman knows that there's a saw for every cutting job. And there's a Nicholson or Black Diamond file that's been designed for keeping teeth keen on every saw made—files for hand saws, crosscuts, chain saws, circular blades. You name the saw, we've got the file to keep it in topnotch cutting condition.

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NICHOLSON FILES
A FILE FOR EVERY PURPOSE

Our Push-Button A-Bomb Is Ready
[*Continued from page 248*]

and I visited in the fog. Dozens of such sites have been selected with great care, surveyed, and examined with an eye to accessibility in an emergency.

Firing data for each site have been prefigured. The birds would simply be trucked in and assembled on the launchers, then roar off into the sky in a matter of minutes.

Even the notorious Eifel fogs, which blanket the mountains from midnight to noon most of the year, are just what the doctor ordered for this mobile program. It certainly would not be healthy for a Matador convoy—birds, cranes, power units, fuel, warheads, RATO jugs, etc.—to be caught by Soviet jets on a clear day on the German highways. They simply

The childish things that upset most adults are usually left scattered all over the house.
—THE SIDEWALK SUPERINTENDENT

wouldn't ever get back in the woods! But under cover of fog they can move freely, as far as danger from enemy fighters and fighter bombers is concerned.

One thing bothered me seriously, however. When Morris and I were in the Bitburg area, we saw no evidence of any organized plan to protect our birds against sudden hit-and-run blows by trained guerrilla fighters. Only one Air Policeman and one K-9 dog patrolled each launching pad.

If war came, it is reasonable to expect that the Russians would strike quickly and hard at our Matador hardware, either with paratroopers or, more probably, through saboteurs already lurking in the area.

The final—and very important—plus factor in the Matador is its cost. This bird, minus warhead, costs $70,000. An F-100 Super Sabre costs $750,000. A B-52 Stratofort costs $7,000,000. Thus, the Matador is probably the cheapest, as well as the toughest to stop, of any transport for an atomic bomb load. END

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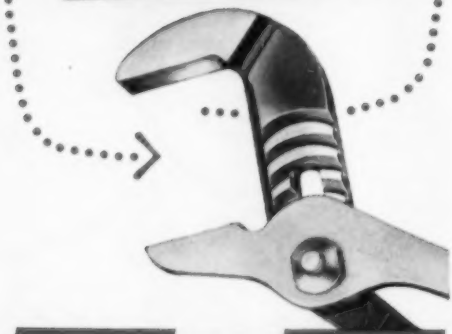

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How to Choose the Right Loudspeaker

[*Continued from page 201*]

little about how well the range is reproduced. They may, however, help you select a woofer or midrange that can serve as a full-range speaker until you add other units later.

Bass resonance. The cone is a weight suspended on springy supports. Like any spring-supported weight, it will vibrate strongly at some particular frequency, a low frequency in this case. Frequencies much below this bass resonance will not be reproduced. Speakers designed for horn enclosures may have a comparatively high bass resonance, but the horn lowers the resonance.

Cone edge. The diaphragm must be supported flexibly enough so that it can move freely through the required distance. Usually the cone material itself is corrugated at the outside edge to provide this springiness. Some makers treat the edge with a plasticizer to make it still more pliable, and more durable, too. This treatment also helps suppress internal vibrations in the cone, which make music sound harsh and uneven. Better yet—on all counts—is a cone unattached to the metal frame and supported by a cloth, rubber or plastic-foam "surround."

Cone mass. The cone should be light in weight to move easily, but rigid enough not to flex. Since some manufacturers specify the weight of the cone only, while others include the weight of all moving parts, figures for different makes are not directly comparable.

Crossover. The music has to be divided among woofer, squawker and tweeter according to frequency. A separate electric circuit usually does this, but some full-range speakers have mechanical crossovers. Here the cone is divided into two segments connected by a flexible section; this connection lets the apex segment of the cone move by itself above the crossover frequency, but makes both segments move together below the crossover.

Tweeters. The small speakers that spe-

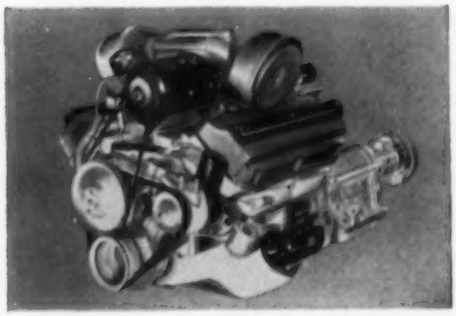
[*Continued on page 254*]

ANNOUNCING THE MIGHTY CHRYSLER 300-C

AMERICA'S MOST POWERFUL CAR! 375 HP!

Chrysler's proud engineers poured all their high-performance know-how into the Chrysler 300-C, the car that out-seats, out-corners, out-controls, and out-powers anything on wheels in this hemisphere. This car is really a bomb!

The Mighty Chrysler 300-C has all the spacious comfort of any of the 1957 Chrysler models. But this is no souped-up stock car; it is built from the ground up to handle the mightiest force ever put under an American hood.



The 300-C's mighty airplane-type engine boasts two four-barrel carburetors and exclusive Chrysler aircraft-type hemispherical combustion chambers. It generates 420 ft. lbs. of torque at 4,000 rpm.

A magnificent leather interior carries out the sports car theme of the Chrysler 300-C—is compatible with choice of body colors. Controls are skillfully arranged for maximum driving ease and safety.

SEE YOUR CHRYSLER DEALER ABOUT THE 300-C

Hardtop and Convertible body types . . . five new colors to choose from.

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for your **HI-FI**
MONEY
with Bell
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RECORDERS

Model PM 2285 — 10 Watt — $49.95*

This new Pacemaker is typical of remarkable Bell value . . . and look at all these features!

★ MORE OUTPUT ★ HIGHER FIDELITY
★ BUILT-IN PRE-AMP ★ HUM CONTROL
★ 20 TO 20,000 CYCLES ★ SEPARATE TONE CONTROLS

This new Pacemaker is only one of the many fine amplifiers and tape recorders manufactured by Bell Sound Systems, all offered at moderate prices.

You can plan your High Fidelity investment for much greater value by finding out more about what Bell offers to you.

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*Priced slightly higher Denver and West.

Yes! Tell me more about Bell High Fidelity Equipment, and the name of my nearest dealer.

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BELL SOUND SYSTEMS, Inc.
A Subsidiary of Thompson Products, Inc.
555 MARION ROAD COLUMBUS 7, OHIO

How to Choose the Right Loudspeaker

[Continued from page 252]

cialize in high notes are made in two types. Instead of cones, some have flat diaphragms, like those in telephone receivers, fastened to horns.

The horn type produces louder sound from a given signal, and usually distributes the sound more uniformly. Some experts maintain, however, that cone tweeters are smoother and color the sound less.

The fine art of listening. Once you have narrowed your speaker choice from the technical specs, you still have to listen to make a final decision. There's a right way to listen, too. Here are some good tips:

- Remember that the cabinet plays a big role in sound quality. Ear-test speakers in the kind of enclosure you plan to use in your system.
- Walk around while you listen. If the sound seems to get thinner as you move to one side, the speaker may not be spreading treble notes sufficiently.
- Take your time—two or three shopping sessions are preferable.
- Keep the volume comfortable. Salesmen like to overwhelm you with loud sound, which is impressive but may be misleading. Loudness may mask characteristics that will sound less pleasant when you hear them at home.
- Watch those "A-B tests." Rapid switching between different speakers can fool you because some speakers make louder sound from the same signal than others do. Be sure the volume control is adjusted after each switch.
- Trust your own judgment. A salesman's advice is helpful, but you're the guy who will have to listen to what you buy, night after night. Choose the one that makes music the way you like it. END

NEXT MONTH . . .
Is YOUR youngster a whiz? Are you helping him or hindering him? An article in the March issue will tell you how to be a good father to a gifted child.

Your CARBURETOR IS DIRTY... AND IT'S COSTING YOU MONEY!

Dirt, gum and varnish accumulate constantly in the carburetor of every car. When this happens—and it must in normal driving—you get . . .

High gas consumption
Rough idling
Stalling
Loss of power

The only cure is to CLEAN THE CARBURETOR and keep it clean!

Carburetor cleaning is easy with GUMOUT . . . inexpensive too. Simply add GUMOUT to your gas tank. It cleans as you drive. Or your service man can run GUMOUT directly through your carburetor while you wait.

You'll get smoother idling, faster pick-up, greater power, no stalling. GUMOUT will save you money in gasoline mileage AND repair bills.

Get GUMOUT today from any auto supply store, or wherever automotive products are sold. There's nothing like it!

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46-page "CARBURETOR HANDBOOK." It's full of helpful information about your car's fuel system.

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Bruce PREFINISHED Oak Floors

By the world's largest hardwood flooring maker

Will Bomb Dust Endanger Your Health?

[*Continued from page 167*]

The black-sheep strontium 90 looks, and acts chemically, exactly like the innocent natural kind. So do its compounds. The big differences are its dangerous radioactivity, and the fact that it's a man-made isotope, not occurring in nature. It's one of the 160-odd radioactive fission products created by nuclear bombs and by uranium-fueled nuclear reactors. It also is one of the longest lived—retaining half its radioactivity for 28 years. Eventually strontium 90 turns into nonradioactive zirconium 90, identical with the kind you dig in a mine.

Probably most of the strontium 90 that fallout has deposited in the soil is in the form of white strontium carbonate. Fallout over all of the U.S. to date has amounted to no more than a scant 10 ounces of this compound, a bottleful that you could stuff in an overcoat pocket. Scattered over 3,000,000 square miles, that seems a mighty tiny amount—but a little goes a long way.

Recent years have brought striking changes in the behavior of fallout. How it gets from bombs to you is a story that throws more light on strontium 90—and on the other much-discussed ingredients of fallout, too.

One March day in 1954, a destroyer detached from a U.S. task force raced at full speed to the atoll of Rongelap in the Marshall Islands. Hustled aboard with more haste than ceremony were 64 bewildered natives, young and old. Then the warship dashed away.

Some hours earlier and 100 miles away, our record-size H-bomb had been exploded. Shifting unexpectedly, the wind bore the radioactive cloud toward supposedly safe Rongelap.

Snow began falling on the island— a strange atomic snow of fine, sticky white particles. It consisted of slaked lime, from bomb-pulverized and incinerated coral, supercharged with radioactivity by fission products that had condensed upon it.

By the time the rescue ship arrived,

[*Continued on page 258*]

TORO

$129.50*... the best you can buy

Extra-heavy steel castings . . . mirror-polished working surfaces . . . years-ahead design features (like the single out-in-front control that either tilts—accurate to 1/10 degree—or raises the blade) . . . all these are yours in the Toro 8-inch Deluxe Tilt-arbor Saw—the *best* table saw you can buy.

Other professional-quality machines in the Toro home power tool line include: a 10-inch Deluxe and an 8-inch Standard Tilt-arbor saw, a 12-inch drill press, 10-inch band saw, 18-inch jig saw, 4-inch belt sander, 4 and 6-inch jointer-planers.

You can see them all and get all the specifications in the latest full-color Toro Power Tool Catalog. For your free copy, mail coupon below.

*Table extensions and stand extra. Prices higher in the West and Canada; subject to change.

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An all new surface-forming tool
Does 1001 jobs

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Plane Type — $3.69

Saves time on all kinds of materials!

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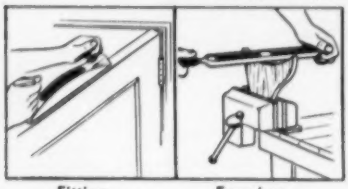
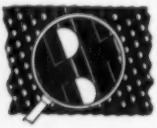


Fitting . . . Forming . . .

Stanley SURFORM forms the surface of wood, plywood, floor tile, hard rubber, plastics, copper, aluminum — even mild steel. It smooths down wood . . . cross grain, with grain, end grain — 12 times faster than other wood forming tools without clogging! It's easy! It's fast! It's safe! It's another Stanley first!

450 sharp edges work together!



This cutting strip is the secret of Stanley SURFORM. The tool steel strip has 450 tough, razor-sharp teeth that really cut, and 450 holes that take the cuttings away from the work. No skill is required . . . you can't go wrong. Nothing to adjust. Depth of cut is automatically controlled.

Tough, long-lasting replacement blade fits both tools — 98¢.

Your hardware dealer has Stanley SURFORM now. Look for it. Try it. For free descriptive Stanley SURFORM folder, write Stanley Tools, Division of The Stanley Works, 632 Elm Street, New Britain, Conn.

STANLEY

The Tool Box of the World

Will Bomb Dust Endanger Your Health?

[Continued from page 256]

the snowy fallout coating the ground had already exposed Rongelap's inhabitants to 175 roentgens of radiation, nearly half the average fatal dose of 400 roentgens. Had they remained on the atoll a few hours longer, most would have perished. As it was, all recovered.

That dramatic episode illustrates one type of fallout—the visible and concentrated "local" kind, of coarse particles that settle to earth within a few hours. Its radioactivity is so intense that its powerful gamma rays are the outstanding peril. Fortunately this kind of fallout extends less than 250 miles downwind from the biggest bombs of all.

More interesting to most of the world is a second kind of fallout, a "distant" and invisible kind. Its particles likewise are coated with radioactive fission products, but are of microscopic size.

Windborne for weeks in the troposphere, the lowest or "weather" layer of the atmosphere, this bomb dust may circle the globe two or three times. When it comes down to earth, borne mostly in rain or snow, much of its radioactivity has died out. Enough remains to make uranium-hunters' Geiger counters falsely proclaim a bonanza—and to pester makers of photographic film, which fallout threatens to fog. From the mixture of fallout ingredients strewn upon the ground, mild gamma radiation bombards people. Long after this has dwindled away, the insidious strontium 90 still lurks in the soil.

At 88 monitoring stations, in this country and 45 others, the AEC has been keeping tabs on the "mixed" fallout by collecting it on squares of gummed film and measuring its overall radioactivity. It has been a little heavier in the U.S. than in any other country, the records show. How its cumulative radioactivity has fluctuated is strikingly shown in a chart for New York City, accompanying this article. The readings would have been somewhat higher in the Middle West; lower toward the West Coast.

[Continued on page 260]

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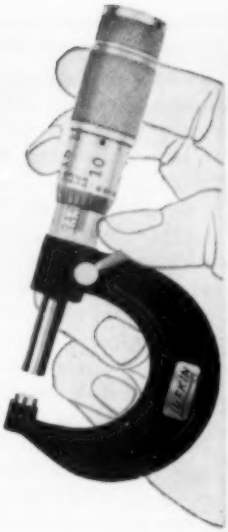
MICROMETERS

With NEW CAM LOCK



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My check ☐, money order ☐ for $_____ is enclosed.
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high fidelity record changer

RC-456
4-speed automatic and manual

The Collaro RC-456 is good news for anyone who has been putting off a high fidelity system because of installation chores. The Collaro record changer is prewired for power as well as audio, and offers the plug-in-and-use convenience of a finished record player.

Two additional installation aids are available as optional accessories: pre-cut mounting board and finished hardwood base. Only one is required depending upon whether you plan an inside-cabinet or open-shelf system.

The Collaro RC-456 offers you these important high fidelity features: heavy 4-pole motor • 4 speeds: 16⅔, 33⅓, 45 and 78 rpm • jam-proof safety clutch • automatic intermix • manual operation • constant, rapid change cycle • minimum wow and rumble • heavy, rim-weighted turntable • automatic shut-off and idler disengage • single knob speed selection • plug-in cartridge shells.

$34.50 *at hi-fi dealers*
(less cartridge) slightly higher West of Rockies.
write to Dept. ZB-23

ROCKBAR CORPORATION
650 Halstead Avenue, Mamaroneck, N. Y.

Will Bomb Dust Endanger Your Health?

[*Continued from page 258*]

Does this fallout's gamma radiation threaten to cause genetic damage, or to shorten your life, as even small doses are believed to do? How slight your exposure actually is has now been shown by the NAS report. The external radiation that an average American may expect to receive during the next 30 years, says the NAS, breaks down as follows: From natural radioactivity, 58.1 percent; from medical and dental X-rays, counting only the stray radiation that reaches the genes, 40.6 percent; from fallout, a mere 1.3 percent.

Natural radioactivity itself ranks well below the permissible external-radiation dose—even a drastic low one newly set for the general public. And so the much smaller external dose from fallout isn't even in the running.

A third kind of fallout, entirely new and different, remains to be described. It has resulted from the first H-bomb of 1952, and subsequent ones. For superbombs of megaton size blow at least half of their radioactive particles clear into the stratosphere, 55,000 feet or more up. And then it's a matter of *years* before the fallout comes down; nearly 10 years, on the average.

By then, virtually all it contains of interest is long-lived strontium 90. (Cesium 137, principal gamma-ray emitter among fission products a year or more old, is so mildly radioactive as to be relatively harmless.) Distributed over the earth extremely uniformly, this new kind of fallout is just beginning to have substantial effect. Since 1955, monitoring stations report, it's become impossible to tell from which bomb-test series a given day's fallout sample came—the old fallout particles are now intermingling with the new.

From this stratospheric reservoir the bulk of strontium 90 from past bomb tests has still to fall upon us. And the problem is becoming urgent of gauging whether any heavier pollution of the world's upper story would return to plague us in years to come. END

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ITEM #415—Designed for remote operation of controls on engines, boats, special machinery, etc. Eliminates complicated mechanical linkages, cables, pulleys, etc. The master unit connects to the slave unit with a single ¼" tube.

When master control lever is moved, slave lever follows exactly. Light, compact, aluminum alloy construction.

Dim. of both unit: 5¼" W, 9" H, 1¾" D, (exclusive of handle) Ship. Wt. 8 lbs. **27.50** per pair F.O.B. Chicago....

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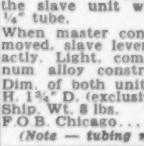
BRAND NEW 1 H.P. 12 Volt Electric Motor



ITEM #309

- For electric wheel chairs (Pop. Mech. design—Mar.-1955)
- For electric golf carts
- For self-propelled scooters, children's midget cars.

Rated 1 H.P.—100 amps., 5600 R.P.M., 12 volts, D.C.—This double shaft motor of ball-bearing construction may be run on 6 volts for lower horsepower requirements—Standard ⅝" shafts, flange mountings.—Dimensions: 9"x4½"x4½". Ship. wt. 19 lbs. A real value at..... **12.50** F.O.B. Chicago

2 H.P. ELECTRIC MOTOR

24 Volts, 90 Amps, 4000 RPM. Spline shaft both ends. Style similar to above. Mfgd. by Hobart or Diehl. ITEM #315 F.O.B. Chicago..... **13.00**

SAVE $30.30 ON THIS PESCO HYDRAULIC CONTROL VALVE

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FOR SAFE POSITIVE CONTROL OF HYDRAULIC CYLINDERS AND MOTORS

—●BUILT-IN RELIEF VALVE—factory set at 1200 P.S.I. ● FOUR-WAY VALVE—to operate one double acting cylinder ● OPEN CENTER—with valve in neutral, cylinder is locked in position and pump is unloaded. ● SPRING RETURN TO NEUTRAL ● FULLY BALANCED PLUNGER ● EASILY STACKED INTO 2, 3, or 4 valve combinations for multiple cylinder operation. ● 8 gal. per min. capacity, at 1500 P.S.I.—⅜" pipe ports ● CONNECT PUSH RODS TO HANDLE FOR REMOTE CONTROL ● EASY MOUNTING ● LIST PRICE—$46.80. ● YOU SAVE $30.30. ● DIMENSIONS—9"x4½"x2½"—Ship. Wt.—8 lbs F.O.B. Chicago..... **16.50**

SELECTED TOP VALUE SPECIALS!

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BELT DRIVEN A. C. GENERATORS

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Ideal for powering electric tools, oil burner, refrigerator, lights, or other appliances requiring up to 1000 watts of power. **1000 WATTS**, 115 Volts, 60 cycles A.C. 3600 R.P.M. Compact, self-regulating generator with V Belt pulley and double outlet receptacle. Rotation counterclockwise. May be driven by tractor or auxiliary gasoline engine. Requires 2½ HP minimum. Dimensions: 10" long x 8" high x 6" wide. Shipping wt. 27 lbs. F.O.B. Chicago..... **79.50**

Model 700—750 Watts A.C. **59.50**

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BRAND NEW HEAVY DUTY TWO UNIT VICKERS HYDRAULIC PUMP

- For Hydraulic Presses
- For Lift Trucks
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The Vickers model V-2129-FLH is actually two hydraulic pumps on a common shaft.

The large hydraulic pump is rated at 21 G.P.M., 1000 lbs. P.S.I. at 1200 R.P.M., for conventional hydraulic system and the small pump is rated at 3 G.P.M. and 1000 lbs. P.S.I. for power steering or for a second hydraulic system. Rotation counterclockwise. Use them individually or collectively.

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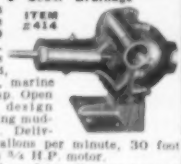
Fine for: — ● Irrigation ● Sump Pumping ● Sewer Drainage

75 gallons per minute @ 2400 R. P. M. Higgins Type PNB, Model R, marine bilge pump. Open Impeller design for handling muddy water. Delivers 75 gallons per minute, 30 foot head with ¾ H.P. motor.

ITEM #414



Pump body and impeller are made of solid bronze, with alloy steel ½" diameter shaft, 1¾" long. Rotation of the pump is clockwise. Inlet has 1½" pipe thread. Plain 1½" outlet for hose connection. Dimensions 12"x7"x8". Shipping weight 23 lbs. F.O.B. Chicago.. **23.50**

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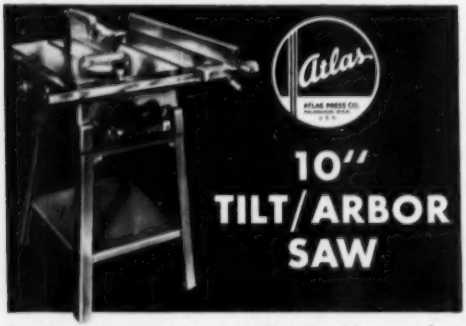
With this superb jointer-planer you can plane, end-joint, tongue, bevel, or rabbet wood of any size with unequalled accuracy, ease and safety. Satin-smooth, ripple-free finish. Larger table and fence, heavier solid-steel cutter-head spindle. This is the jointer-planer you need to give your work that professional quality. Ask any experienced woodworker. Write for descriptive literature.



With this precision ATLAS 10" circular saw you can do almost every basic woodworking operation . . . faster, more accurately, and with greater safety. You can crosscut, rip, miter, dado, and shape with greater ease, precision, and smoothness. Unexcelled for general carpentry, this great saw also gives you versatility you need for fine cabinet work, built-ins, trim, and furniture projects. It's the only saw with rigid triangular arbor support, balanced tilt mechanism, bigger arbor, push-pull depth and angle control, and double-locking lift-off fence with vernier control.

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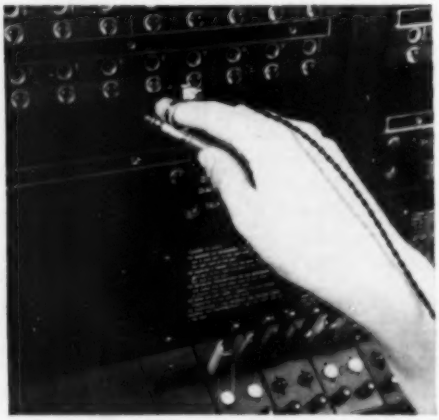

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WITH this electronic fingertip "eye," blind telephone operators watch for incoming calls. When the switchboard buzzes, the transistor passes the lamps until activated by a lighted one. A headset signal tells the operator to plug in the cord.

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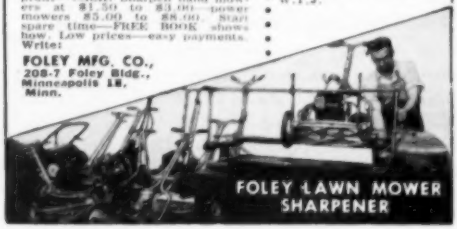

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you're wasting money driving with those worn-out piston rings

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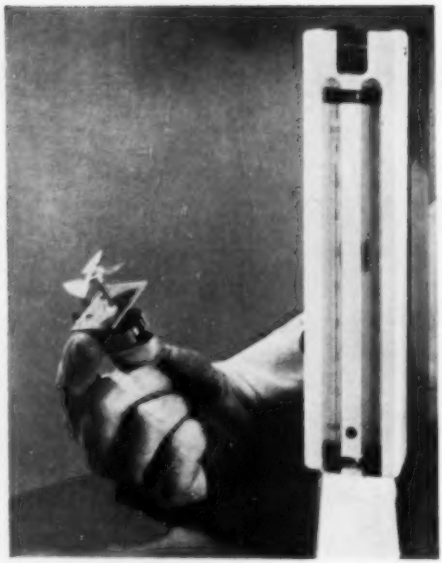
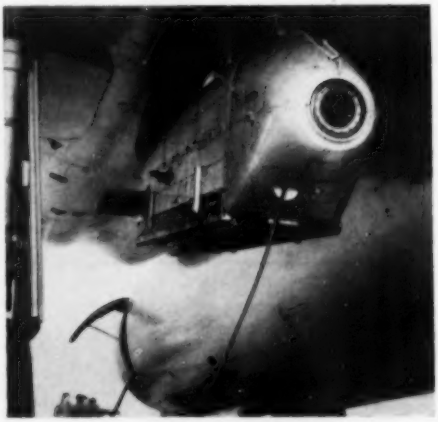


Fan Cools Weather Instrument

A TINY battery-powered fan (above, left) wafts air at 10 m.p.h. across wet and dry thermometer bulbs (right) in a new humidity-measuring device. The Friez "Psychron" will be used by the Weather Bureau and in industries where precise humidity control is vital to production.



Rocket Engines Parachute Home

A ROCKET engine like this under each wing puts an extra kick in British jet bomber takeoffs. At around 1,000 feet the plane releases the De Havilland Super Sprites. They parachute back to give another Vicker Valiant a takeoff boost.

WAR SURPLUS AND OTHER BARGAINS SAVE UP TO 90%

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For boats, trucks, cars. By Pioneer Instrument Co., div. Bendix. Mark VIII. Graduated in increments of 1°; 360°. Major graduations every 5°. Magnetic. Can be lighted with 6, 12 or 24 volt standard bulb. Flush panel mounting. Approx. GOVT. COST $250. Perfect . . . $10.95 ppd.

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Complete make-up package consisting of 1 Aircraft DC Generator, Electric Auto-Lite 160-240 Amps. 24 Volt. RPM from 2600 up. 1 Rheostat, 1 Giant Toggle Switch. 1 Ammeter. 1 Shunt, 0 to 240 Amps. 1 Voltmeter, 0 to 30 Volts. 1 Electrode Holder. 1 Welder's Shield. 1 Voltage Regulator. Wiring diagram for hookup as welder. Wt. under 100 lbs. Approx. GOVT. COST $475. Like new, perfect . . . $27.95.
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Quick, handy, accurate. 6" Vernier Calipers. Glass hardened, lapped measuring surfaces. Fine engraved scales—1/1000" and 1/16mm for inside, outside & depth measurements. Friction thumb release. Larger capacity. 2 kth adjustments. Reg. $25. Now only $7.95. Leather case $1 extra.

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PERMANENTLY mends cracks or holes in wood, tile, stone or plaster. Sticks and stays put—Does not chip, shrink or fall out. Easy to use. Economical. Mold it, chisel it, polish or paint it. The big 4-lb. can is obtainable from your lumber, paint or hardware dealer at $1.25; or will be shipped direct postpaid (in U. S.) for $1.50. Complete satisfaction guaranteed or your money refunded. Order now.

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Straight, curved, single or double
With any color paint, stripe furniture, bikes, autos, model planes, toys, linoleum, wallboard. Clean, crisp decorative lines. Can't clog or smear. Also use with glue, tempera, textile paint or underglaze . . . on wood, glass plastic, ceramics, metals, fabrics and paper.
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Single 1/16" stripe model $1.25
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EASY TERMS ONLY $98.50 F.O.B.

Now you can own a Trindl full 125 amp Industrial Welder at a price far less than smaller machines. With a Trindl 125A you can weld metals up to ⅛ inch thick. Operates off either 110 or 220 volt line, properly wired. 16 heat stages from 20 to 125 amps. Make and repair anything of metal around the home, garage, farm or shop, like a professional. No previous experience or training needed. Full "do-it-yourself" instructions with each machine. Complete only $98.50 f.o.b. factory, or write for details. Trindl manufactures a complete line of heavy duty welding machines. Dealer inquiries invited.

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12 MONTHS IN CONTINUOUS OPERATION

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8 BOAT PLANS
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PERFORMANCE TESTED ARCHITECT DESIGNED
See your lumber dealer or use coupon below.

Large, easy-to-follow plans contain illustrated step-by-step instructions and complete bill of materials.

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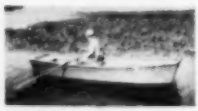
No. 35. 11' 3" Outboard

No. 40. 13' 4" Outboard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*Use Only Exterior Fir Plywood For All Marine Construction
(EXT-DFPA® Means 100% Waterproof Glue!)

Douglas Fir Plywood Association, Dept. 11, Tacoma, 2, Wash.
Please send plans checked below. I enclose 25c for each. (Good in U.S.A. only)

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The Cars We'll Buy in the Next 10 Years
[*Continued from page 124*]

tooling would make big initial sales imperative. If this happened, the revolution in filling stations, repair services, parts making and the oil industry would reach earthquake dimensions.

The free-piston engine is a still newer contender. All the Big Three are working on it. In effect, it is a combination of the diesel and the gas turbine. The diesel part, or "gasifier," compresses gas, which is piped to a turbine that drives the wheels. The compression ratio is variable, but A. F. Underwood of GM's research staff says that it runs from 25:1 at idling up to 50:1 at full load. (Top orthodox diesel compression ratios are about 19:1.) This engine cares nothing about octanes, and will burn anything from aviation fuel to kerosene. It has been run on vegetable oils as a stunt, as the early diesels were.

Two gasifying units are mounted side by side in front on GM's sleek XP-500 free-piston pioneer car. Their gases are piped through a single tube to the drive turbine on the rear axle. This gas pipe follows the side of the car, so there is no awkward floor tunnel. In the future, says Underwood, engineers may select a gasifier unit of the most efficient size and line up as many as are needed for the total power required. Free-piston engines have been built in sizes ranging from 10 to 6,000 hp. Last year 79 were in use, mostly for marine and stationary power.

"This engine has one big advantage over the gas turbine," says Underwood. "The temperature of the gas is only 450-900° F, so we don't need critical metals. You can arrange the units any way you like—put the whole power plant in front or behind, or split them up, as we have. There is no time-lag problem as in the gas turbine. It makes possible a simplified transmission and you might eliminate it entirely. You could do away with the reverse gear by bypassing the gas around

[*Continued on page 268*]

America's first and finest Reciprocal-Action Saw

NEW *WHIZ-SAW* MODEL NO. 10

OUT-PERFORMS HIGHER PRICED SAWS

Extremely high powered and low, low priced. Forsberg's newest Whiz-Saw—Model No. 10—rips and cross-cuts two inch finished lumber with ease and speed—3250 blade strokes per minute. Makes inside cuts without boring a starting hole . . . handles easily . . . safe to operate . . . guaranteed for long service. Made by the Mfr. of the "original Whiz-Saw." Now available at leading hardware stores. Choice of 4 models.

THE FORSBERG MFG. CO., BRIDGEPORT 1, CONN.

it's NEW! it's ALL IN ONE LEVEL·SQUARE·TAPE

KEUFFEL & ESSER CO.
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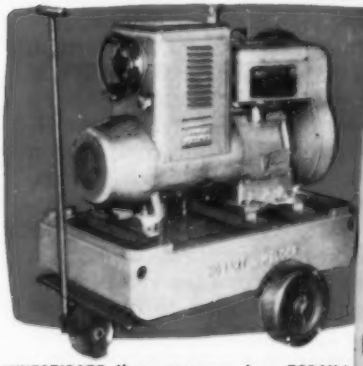

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EARN BIG PROFITS!
CASH IN- on the big demand for emergency repair work

LOW INVESTMENT . . . low cost operation

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Mail Coupon and receive welder's vest pocket guide **free**

In or out of the shop this Husky Boy arc welder can earn big profits for you and will quickly pay for itself out of increased earnings. Welds anywhere. Light weight and easy to use without special training. Cash in on the big demand for arc welding. Get into the bigger paying jobs now —write **Hobart Brothers Co.**, Box P-27, Troy, Ohio, 'Ph. FE 2-1223.

HOBART TRADE SCHOOL . . . learn arc welding quickly by actual on-the-job experience. Complete or partial courses. G.I. approved. Non profit.

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200 amp. light weight, low cost "BANTAM CHAMP" is specially designed to let you do production and repair work in your own shop.

200 amp. TRANSFORMER AC welder for operating on single phase 220 volt power. Ideal for shops that would like to do production and repair work.

200 amp. AC Power-AC Welder Combination. Four cylinder air cooled engine. Furnishes current for welding—power for running tools, lights, etc. Mounts easily on truck or trailer.

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Without obligation, send complete details on:
☐ 200 amp. "HUSKY BOY" ☐ 200 amp. "BANTAM CHAMP" ☐ 200 amp. AC TRANSFORMER
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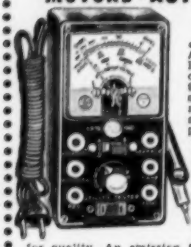
☐ Send Free Welder's Vest Pocket Guide.

Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS · AUTOMOBILES · TV TUBES



AS AN ELECTRICAL TROUBLE SHOOTER THE MODEL 70:

• Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc. • Will measure current consumption while the appliance under test is in operation • Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc. • Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms) • Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Fans, Switches, Thermostats, etc. • Will test all TV tubes for open filaments, inter-element shorts, burned out tubes, etc. (Will not test TV tubes for quality. An emission type tester such as the Model TD-55 described below is required to test tubes for quality).

AS AN AUTOMOTIVE TESTER THE MODEL 70:

• Tests both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Handsome round-cornered molded bakelite case, 3¼"x5½"x2¼". Complete with all test leads. Also included is a 64 page book giving detailed instructions, for testing all electrical appliances, automotive equipment, TV tubes, etc. Only **15.85**

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TUBE TESTER

QUICKLY AND EFFICIENTLY TESTS RADIO AND TV TUBES INCLUDING: SEVEN PIN MINIATURES; EIGHT PIN SUBMINARS, OCTALS AND LOCTALS; NINE PIN NOVALS

YOU CAN'T INSERT A TUBE IN THE WRONG SOCKET. It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested. **"FREE-POINT" ELEMENT SWITCHING SYSTEM.** The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap." **CHECK FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS.** The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. **ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATION.** One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TD-55 comes complete with operating instructions and charts. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and back of instructions. **26.95**

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NO MONEY WITH ORDER—NO C.O.D.

Try either of the above instruments for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied, return unit to us, no explanation necessary.

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Please rush the unit(s) checked. If satisfactory, I will remit down payment within 10 days, and the balance at the monthly rate indicated below. If not satisfactory, I may return merchandise for cancellation of account.

☐ Model 70 . . . Total Price $15.85 —$3.85 within 10 days. Balance $4.00 monthly for 3 months.

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All prices net, F.O.B., N.Y.C.

The Cars We'll Buy in the Next 10 Years

[*Continued from page 266*]

the drive turbine and putting it through a reverse turbine.

"***Once we burned a lot of fuel*** at idling, but we have improved that. Even in its early stages this engine is about even with the present auto engine in fuel economy. I believe we can do much better. One serious disadvantage—it weighs too much. We think we can sweat it down."

Says Dr. Donald N. Frey, associate director of the Ford Scientific Laboratory, where they have a free-piston engine similar to GM's: "There is a firm conviction among many engineers that the present automobile engine will be replaced in 10 years or so. The higher the compression, the more critical the problems are. A somewhat lighter and smaller free-piston engine seems a likely candidate. There is also a distinct possibility that the free-piston will replace today's diesel."

Some kind of compression ignition for the passenger car is predicted by many experts. Dr. P. F. Martinuzzi, former chief designer for the British Sunbeam car and now professor of mechanical engineering at the Stevens Institute of Technology, reasons as follows: "Horsepower and compression ratio will continue to rise in the immediate future. The higher the compression ratio, the trickier will be prevention of pre-ignition, which can destroy an engine in a few minutes.

"The only solution is to inject fuel late in the cycle, and that leads directly to a compression-ignition engine. Diesel passenger cars, now fairly common in Europe, lack the verve of the gasoline car. A two-cycle, supercharged diesel could be developed to match the performance of the gasoline engine, but it would take a lot of engineering and the car would not be cheap. The free-piston engine could be ready in about three years . . ."

The automotive diesel? This has been developing slowly but surely.

[*Continued on page 270*]

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new rooms for old with soilproof Marlite paneling

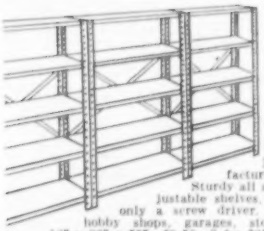
Marlite paneling takes the mystery out of remodeling. Over a weekend you can install the easy-to-handle sheets, planks or blocks right over your old walls. No plastering, painting, papering! And Marlite's melamine plastic finish resists scuffs, grease, moisture; wipes clean with a damp cloth. See your lumber dealer for Marlite in beautiful colors, wood and marble patterns for any room in your home. Or send 10c for 16 page, full color decorating book to Marlite Division of Masonite Corporation, Dept. 226, Dover, Ohio.

Marlite®
plastic-finished
WALL and CEILING PANELING

ANOTHER QUALITY PRODUCT OF MASONITE® RESEARCH

LOWEST PREPAID PRICES ON QUALITY

STEEL SHELVING



ONLY
$9.95
FREIGHT PREPAID
3 for only $27.85

Buy directly from the manufacturer, freight prepaid and save. Sturdy all steel construction. Five big adjustable shelves. Back-braced. Assembles with only a screw driver. Hundreds of uses in homes, hobby shops, garages, stores, shops, offices etc. Size 12" x 36" x 72"—$9.75—3 for $27.85. 15" x 36" x 75"—$11.95—3 for $33.85. 18" x 36" x 75"—$13.95—3 for $39.85. All prices freight prepaid. Money back guarantee. Send check, cash, or money order.

As shown
24" x 72" x 34"

BIG, LOW COST, STURDY
WORK BENCH

$9.95 FOR HARDWARE
$16.95 COMPLETE

Buy the hardware—add length top desired. Rugged, wobble-free steel construction. Nuts, bolts, screws included. Available with 2 x 12 lumber top, 2 x 12 lumber utility shelf, 1 x 8 back board—$16.95. Hardware only — $9.95. Money back guarantee. Sent freight paid if ordered with shelving.

RIVERBED METAL PRODUCTS CO.

Dept. PS-2, 1250 Riverbed Cleveland 13, Ohio

There's power in this end, too!

Electric drill power isn't all in the motor. There's another kind of power — just as important to you — in the business end of a portable electric drill. It's the gripping power that has to be in the chuck, particularly when you are using sanding and screwdriver attachments that must be chucked on the drill.

Take the drill shown here. It is equipped with a Jacobs Model 6141 Rubber-Flex Hex-Key Chuck. You cannot buy a more powerful grip on a portable electric tool. It is compact, light in weight, and easy to operate. Buy the drill and buy the chuck. Jacobs is a name men go buy!

This Jacobs Hex-Key Chuck *looks* different because it *is* different. A quarter turn of a standard Allen key produces tremendous holding power. It actually produces a gripping leverage ratio of 1000 to 1! Another quarter turn easily releases the twist drill.

Jacobs
RUBBER-FLEX COLLETS

Reg. U.S. Pat. Off.

The Jacobs Manufacturing Company
West Hartford 10, Connecticut

solves woodworking problems in seconds!

Speed your jobs, get answers to countless building and woodworking questions immediately! Improved GREENLEE Woodworking Calculator converts linear to board feet, gives nail specifications, tool sharpening tips. Compares woods, gives bit sizes for screws, concrete mixes, painting information, etc. Convenient . . . simple to read. 6" diameter . . . heavily varnished cardboard. Special offer by the makers of famous GREENLEE tools . . . **Only 25c**

(no stamps please)

The Cars We'll Buy in the Next 10 Years

[*Continued from page 268*]

Fifteen years ago I rode with Clessie Cummins, pioneer in truck diesels, in the diesel-powered Auburn in which he made his famous coast-to-coast run at a fuel cost of $7.68. It shook at the curb like a Model T Ford, and didn't calm down until he got it up to 70. Two years ago in Coventry, England, I rode in the first of the Standard Motor Company's Diesel Vanguard Saloons, and noticed little vibration.

About 600 taxicabs in London then had the yellow fuel-tank caps that marked them as diesel-powered; passengers not aware of this had no idea what was under the hood. Today, nearly half of greater London's fleet of about 5,900 cabs are run by diesels, most of them Standards, and the highly efficient oil engine drives about 90 percent of the new cabs registered. In Brussels, 300 British Perkins diesels have been installed in Plymouth taxis.

Since diesels get about twice the miles per gallon as gasoline vehicles, Suez-caused fuel shortages should spur the adoption of the diesel. In England there is no advantage over gas in cost because of taxes, but in parts of Europe diesel oil is much cheaper.

No one can blueprint the car of the future without considering the world's petroleum resources. Eugene Ayres, a leading expert on energy resources, recently predicted that production of oil will begin to decline in the U. S. in 10 or 15 years, and in the rest of the world not very long afterwards. "It seems certain," he says, "that production of petroleum will have fallen far behind demand by 1965. No conceivable find of new reserves could long postpone the evil day."

Our powerful rolling palaces, it would seem from this, will continue to carry us for a few years. Beyond that, the crystal ball shows a cloudy vision of a small, economical passenger car that will burn a kerosene-like fuel, or whatever the refiners can produce in greatest quantities. END

EXTENSION CORD

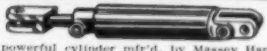
Heavy duty and very flexible. Neoprene 14-2 cable. 20 year quality. Wt. 12 lbs. (Item 185) 100 ft. Complete with rubber plug and outlet. A terrific buy at only **$8.95**

No. 10-2 Power Cable. Heavy duty, very flexible, 20 ft. with male and female fittings. Wt. 4 lbs. (Item 818b) **$5.15**
20 ft. without fittings (818a) **$4.15**
50 ft. (Item 592) with fittings **$13.45**
100 ft. (Item 135) with fittings **$25.95**

No. 12-2 Power Cable. Very flexible rubber covered, special outside shield for grounding power tools, etc. 50 ft. (Item 199) Wt. 8 lbs. **$6.95.** 100 ft. (Item 200) **$12.95**

No. 8-2 Conductor Power Cable. 30 ft. heavy duty, very flexible rubber covered with male & female plug (Item 817) **$12.95**

Double Acting Hydraulic Cylinder



A powerful cylinder mfr'd. by Massey Harris which develops both a pushing and a pulling action. Will push 8,100 lbs., with a 1000 PSI pump pressure. Cylinder is 3¾" O.D. with 6½" stroke—standard heavy duty clevises on both ends. Has standard ⅛" pipe thread openings. Can be used for tilting buckets or blades, raising or lowering implements, hydraulic presses, etc. Can also be used as an air cylinder. (Item 802) Wt. 17 lbs. Reg. $68 value. Special **$14.95**

OTHER DOUBLE ACTING CYLINDERS

8" stroke—3" bore **$34.00**
10" stroke—3" bore **34.80**
16" stroke—3" bore **43.00**
24" stroke—3" bore **47.50**

HYDRAULIC CONTROL VALVE—4 way open center valve with built-in adjustable relief; easily mounted; finger tip control. Wt. 16 lbs. (Item 822) **$21.50**

GIANT METAL SHEARS

"PEXTO"

Nine inch cutting blade made of special high carbon alloy steel, perfectly aligned and ground. Easily cuts steel plate up to 12 gauge or ⅛" thick. Overall length 40". Wt. 23 lbs. (Item 158) Reg. $49.50, While they last **$14.95**

BUY at dealer prices
direct from MASTER MECHANIC

MASTER AIR COMPRESSOR

Tank Tested up to 500 lbs. per sq. in.

COMPARE! This is the only compressor built with a NO RUST stainless steel tank. Safe up to 500 lbs. (Item 209) High pressure type (4 c.f.m.) Large volume of air for heavy duty service. For paint spraying, inflating truck & auto tires, greasing, sand blasting, etc. Piston type 2" bore compressor with built-in air filter. Master built with high strength alloys and precision bearings. Tank, 12"x24", 2100 cu. in. cap. Equipped with automatic switch that starts and stops motor to maintain desired pressure (up to 150 lbs.) and check valve, safety valve, gauge, shut-off valve, 20 ft. air hose and tire chuck. Beautifully balanced on ball bearing wheels and rubber tires. Don't take chances with used or surplus equipment. Our compressors are factory new and are guaranteed **SAFE**. Low factory price. ¼ HP Model (cap. 85 lbs.) Reg. $175. (Item 209) **$109.50**

½ **HP heavy duty model**, Rep.-Ind. motor & unloader switch (Item 209a) **$129.50**

52 pc. SOCKET SET

Highest quality, guaranteed non-breakable sockets made by Husky. Beautifully matched chrome thin wall alloy absolutely the best. Contains a complete set of 28 sockets in ½" drive, ⅜" drive and ¼" drive, plus all necessary extensions, handles, speeders, reversible ratchets, etc., all unused, guaranteed against breakage. A beautiful set of tools that will handle any job; in a big doghouse steel box. Wt. 17 lbs. (Item 205) List price $62.00. Factory special **$29.95**

PORTABLE LIGHT PLANTS

(Item 24)

700 WATTS PUSH BUTTON START

115 v., 60 cyc. AC Powered by a rugged 2.2 HP easy starting Briggs engine. No wiring necessary, just plug in and operate. Plenty of current for any oil burner, freezer, brooder, emergency lights, etc. which require up to 700 watts. Ideal for television and radios. Complete with Voltmeter and built-in winding to charge 6 v. auto batteries. (Item 24.) Wt. 75 lbs. Easily fits in car trunk. Be prepared if storm knocks out power lines. Reg. $275 value **$143.50**

1200 Watt Plant (Item 45) same as Item 24 but larger generator and engine with 50% greater output **$199.50**

1500 WATT PLANT—Push Button Start 115 v. 60 cyc. AC. Powered by a big 3½ HP Clinton engine. Combines big output with easy portability. Provides emergency power for operating any oil burner, sump pump, freezer, television, lights, communication systems, etc. which require up to 1500 watts. Includes voltmeter, duplex power receptacle and built-in winding for battery charging. Wt. 110 lbs. Reg. $475 value, factory price **$239.50**

PORTO-POWER 1750 Watt Plant

(Item 30)

115/130 v. 60 cyc AC. Push button start. Powered by a 4.5 HP Briggs engine. Combines compactness and easy portability with higher output for handling heavier starting loads. Ideal for operating oil burners, sump pumps, freezers, television, lights, communication systems, etc. Perfect for contractor's power tools. (Item 20). Wt. 146 lbs. Factory Special Price **$279.50**

2500 WATT PLANT—Push Button Start (Item 21) 110/120 v. 60 cyc. A.C. A rugged powerful plant. Reg. $645. Spec. **$329.50**

3500 Watt Plant Push Button Start (Item 23) 115 v. 60 cyc. AC. Similar to above, but larger and 33⅓ more capacity. Wt. 270 lbs. Reg. $760. Factory Price **$379.50**

DUAL VOLTAGE 110/220 for Item 21 or 23 —$30 additional.

Send check or M.O. Prices f.o.b. Factory. 10 day Money back guarantee. SEND 10¢ for ... BIG 1957 Catalog

MASTER MECHANIC MFG. CO., DEPT. 94-P **Burlington, Wis.**

We make every type and size of light plants.—Write, giving us your requirements.

BOAT KITS 28 MODELS-8 to 19 ft. $39 up-FREE FREIGHT

SAVE 2/3!
Easy-to-build
MAHOGANY
DECKS & FRAMES
SEND 10¢ for CATALOG
Includes Hardware-Trailers-Fiberglas

Boat Plans-Patterns-Frame Kits

Build over 50 modern boats from large scale plans, available with FULL-SIZE patterns, new PRE-FAB frame kits! All types: proms to cruisers, 6 to 25 ft. Best buy for Ameteurs! SEND 10¢ for CATALOG.

Craig-Craft Tonawanda, N.Y.

Attachable Cutter Blades

Electric Unit cleans pipes 3" to 12"

CLOGGED SEWERS?
REMEMBER THE COSTLY PLUMBING BILL—

Chicago—Feb. 1st. Just Introduced is a Free Booklet on machines which enable the Home Owner, Janitor or Factory Maintenance Man to Rod-It-himself—

Yet anyone can operate this **new Rodding Tool** which is whirled down the drain in a few seconds. SINKS, BATHTUBS, TOILETS, URINALS, FLOOR DRAINS, HOUSE TO STREET SEWERS can be cleared of Rags, Grease, Paper, Sand while Cutter blades can be added for removing roots. A new discovery in Swedish Music Wire gives the rod 100% more Flexibility.

Another new unit is the Miller Electric Rodder which has patented cutters that expand automatically to the size of the pipe. It will clean out heavy obstructions in pipe diameters 3" to 12". Smaller Sizes available. But now, what are these Tools worth in **COSTLY PLUMBING BILLS SAVED.** Tear this Ad out—and write your name and address beside it for **FREE BOOKLET** on Hand and Electric Units. Obey that urge. No Agent will call. A postcard will do (Chicago Phone Kildare 5-1792.

MILLER SEWER ROD, Dept. TS-2
4640 N. CENTRAL AVE., CHICAGO 30, ILLINOIS

Kean Kutt says...

SHARK BRAND SWEDISH CHISELS MAKE HARD JOBS EASY because of

SWEDISH CHARCOAL STEEL

The steel used in Shark Brand Chisels contains fewer impurities than steel made with coal or coke and when it is properly annealed and tempered becomes **tough** but not brittle and therefore they hold their edge much, much longer.

...but there's more to why Shark Brand Chisels outlast and out perform ordinary chisels. Ask for them at your hardware dealer ... write for new free booklet Dept. PS

Sandvik STEEL, INC.
Saw & Tool Division
1702 NEVINS RD. FAIRLAWN, N. J.

IN CANADA: P.O. DRAWER 1330 STATION "O" MONTREAL 9

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THOUSANDS OF NEW ITEMS

1957 EDITION JUST OUT!

FIRST 1957 ACCESSORIES

Parts and Accessories for all makes and models of cars from 1920 thru 1957!

Saves UP TO 50% on all parts for your car, truck, hot rod, custom car or station wagon—all models.

Get your FREE copy now . . . everything you need for your car, truck, custom styled car or hot rod. Save up to 50% buying-by-mail from Whitney! Thousands of hard-to-find items for cars from 1920 to 1957. See newest Hollywood accessories not offered in stores; high speed and power parts, custom styling equipment . . . all at lowest prices! Guaranteed satisfaction or money back. Our 20th year. Mail coupon.

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Rush giant 1957 catalog of auto parts and accessories at sale prices. I enclose 25¢ to cover part of mailing and handling cost, which will be credited to me on my first $5.00-or-more order.

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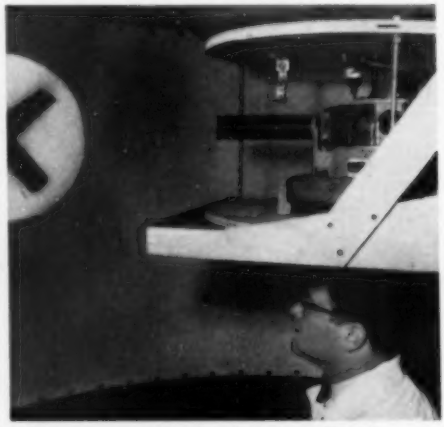
Address_____

City_____ State_____

Mower Powers Gas Pump

ELECTRIC power failures present no problem to service-station owner Harold Petersen of Ossining, N. Y. He simply wheels out his power mower, runs a V belt from its engine to the driving mechanism of an immobilized gas pump, and rings up the sales as usual.



"Cinerama" Tests Eyesight

GEOMETRIC patterns, flashed across a curved screen by a revolving projector, are used by researchers at UCLA to test a driver's vision. Better than fixed charts, they determine a motorist's ability to see moving objects on all sides.

Next time... use AMBROID®

IT STAYS STUCK!

First and still the strongest liquid cement made, AMBROID *penetrates* surfaces to join parts forever. Withstands tremendous pressure! Water-proof. Hot fuel-resistant. Patch your canoe, repair delicate pottery, construct heavy models . . . *with confidence!* Use AMBROID . . . unsurpassed for all wood, leather, metal, fabrics, glass, pottery, china, plastic.

2 oz. tube 30¢ 4½ oz. tube 60¢

Craftsmen's choice since 1910

AMBROID COMPANY
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GET FREE CHART* SHOWING HOW TO SELECT THE RIGHT SCREW FOR THE RIGHT JOB

Buy 'em by Name, Buy 'em by the Box and Save!

Southern SCREW COMPANY

Wood Screws
Tapping Screws
Stove Bolts
Machine Screws

*Write for TC-4
SOUTHERN SCREW CO., Box 1360-PS, Statesville, N. C.

your best buy in a paint sprayer

Pressure Maid is the most efficient small portable paint sprayer on the market . . . bar none. *Piston-type* . . . not a diaphragm. Direct drive! Rugged, compact one-cylinder air tool for home craftsman without special skill. Precision-built. Trouble-free. *Complete!* Sprays paints, varnishes, enamels, insect sprays. One job pays for it.

Write 151 Railroad Ave., Harrison, Ohio
naming dealer

CAMPBELL-HAUSFELD

NEW

Starrett

"Satin Chrome" STEEL RULES

(Pioneered by Starrett)

"Satin Chrome Finish", the no-glare, hard wearing, multi-plate finish, pioneered by Starrett, is now available on most Starrett Steel Rules in 6 to 72-inch lengths with fractional or decimal graduations. Satin Chrome blades also available for combination squares, sets and bevel protractors. You can read these rules faster, easier in any light, without eye-strain or errors. Satin Chrome Finish also resists moisture, acids, perspiration, rust and stains.

DECIMAL GRADUATED RULES

In addition to these new Satin Chrome Finish rules, Starrett offers a full line of standard steel rules and shrink rules decimal graduated in quick-reading 10ths and 50ths in accordance with approved industry standards. The complete line features full-flexible, semi-flexible, spring tempered and heavy spring tempered types. Also, decimal graduated blades for Starrett combination squares and bevel protractors.

BIG NEW CATALOG — FREE

Describes and illustrates over 3000 Starrett Tools. Write for it. Address Dept. PS.

THE L. S. STARRETT CO., ATHOL, MASS., U. S. A.
Since 1880 — World's Greatest Toolmakers

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MECHANICS' HAND MEASURING TOOLS AND PRECISION INSTRUMENTS
DIAL INDICATORS • STEEL TAPES • PRECISION GROUND FLAT STOCK
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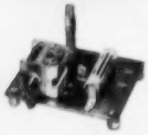
have fun with electronics

BUILD YOUR OWN **knight-kit**

IT'S EASY— AND YOU SAVE!

KNIGHT-KITS are famous for their clear "step-and-chek" instructions. You'll marvel at how easy they are to assemble. You'll be thrilled with their performance—proud of your work. You can't miss—and you save money!



Transistor Radio Kit

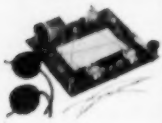
Experiment with the marvel of transistors! Printed circuit mounting board simplifies assembly—just make a few solder connections. Delivers fine broadcast reception. Fits in palm of your hand; powered by penlight cell that lasts for months. Complete with all parts, transistor, penlight cell. Shpg. wt., 2 lbs.

83 Y 765. Transistor Radio Kit.... **$4.35**
83 Y 266. Headset & Antenna Kit... **$3.15**

Famous 2-Band "Space-Spanner"

Thrilling new bandswitching receiver. Selects exciting short wave on 6 to 18 mc (foreign, amateur, aircraft, police, marine); and full regular broadcast. Sensitive regenerative circuit; 4" PM speaker; beam-power output. Easy to build. All parts supplied (less cabinet). 4½ lbs.

83 Y 243. "Space-Spanner" Kit. **$15.95**
83 Y 247. Cabinet for above..... **$2.90**



Transistorized Electronic 10-in-1 Lab Kit

Sensational—work with transistors! Assemble the basic parts, then complete project after exciting project (10 of them in all) just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio, amplifier, wireless broadcaster, code practice oscillator, electronic timer, switch, flasher, or any of 3 other electronic relays. Includes all parts, 2 transistors, battery, headphones and instructions for each project. Shpg. wt., 3 lbs.

83 Y 299. Electronic Lab Kit.... **$15.45**

2-Way Intercom Kit

It's easy and inexpensive to build your own 2-station intercom! Use it in home or office. Makes ideal "baby sitter". Extra high gain—delivers full output from only a whisper. Complete with 50 ft. cable (up to 200 ft. may be added), antique-white cases, tubes and all parts. For AC-DC. 7 lbs.

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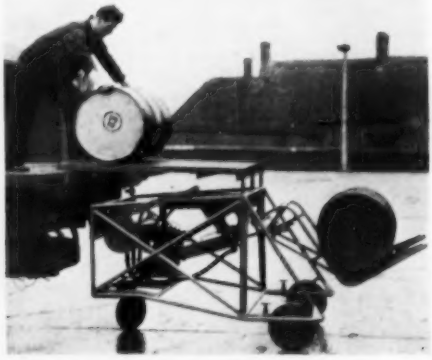
Roof-Top Tank Gives Car a Bath

WHERE there's no garden hose handy, this roof-top tank with rubber feet makes car washing easier. Clear or sudsy water is fed to the plastic sponge through a hose that clips on the user's arm to keep it out of the way. The Portable Car Washer Co., Glasgow, Scotland, makes it.



Rocking Loader Moves Cargo

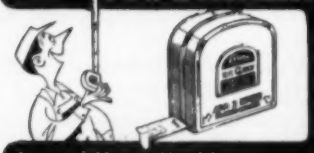
BARRELS, cases and other truck cargo can be loaded and unloaded fast with the mobile platform above. Freight eased onto a hinged rocker arm at right is raised or lowered by a hydraulic pump run by a 2½-hp. motor. A. J. Mackaness, Ltd., London, calls it a Trolliloader.

ONLY $2.39 (10 FT.)

MEASURES UP! the *Evans* KING-SIZE TAPE

IT STANDS UP STRAIGHT

6-8-10-12 FOOT LENGTHS



Long upright measuring jobs are easy with Evans King Size. Blade is a full ¾" wide . . . 33% wider than ordinary tapes. Stands straight up or lays down flat — won't bend or buckle. Easier to read, too. Free belt clip, Tenite utility case. Sliding end hook — for 100% accurate inside-outside measuring.

Exclusive! NO FIGURING!

Work in feet & inches? Read here ▶
Work in inches? Read here ▶

ALSO . . . get *Evans* Regular White-Tapes

- 6 Ft. only 98¢ 50 Ft. only $4.98
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Ask your hardware dealer — Today!

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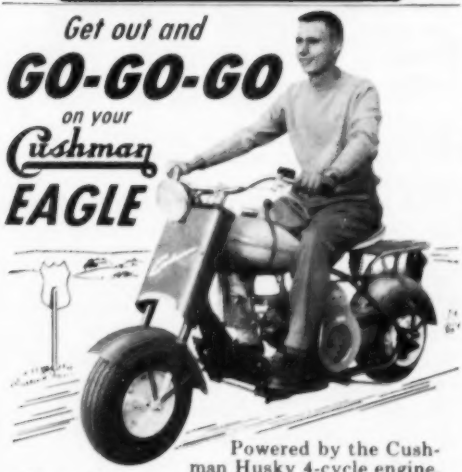
Get out and

GO-GO-GO

on your

Cushman

EAGLE



Powered by the Cushman Husky 4-cycle engine. Up to 50 miles per hour, 100 miles per gallon. Distinctively designed and ruggedly built for flashing beauty and a smooth, soaring ride. Go anywhere, everywhere for just ¾ cent per mile.

- Sold and serviced nationally; replacement parts available immediately
- See your Cushman dealer for FREE demonstration ride or write for illustrated booklet
- Dealer inquiries invited

Write for new FREE booklet today

CUSHMAN MOTOR WORKS, INC.

912 No. 21st, Lincoln, Nebraska

if you have to glue it . . .

LET ELMER DO IT!

Repair or build quickly with strong

ELMER'S® GLUE-ALL

Use Elmer's modern plastic glue for any porous material such as wood, paper, cloth or pottery. It's easy to apply, fast drying and won't stain. Takes the goo out of gluing. Perfect for the home workshop.

Get a completely waterproof bond with

ELMER'S® WATERPROOF GLUE

It's the glue that boating experts use. Apply on any joint subject to water, weather, acids or alkalis. Super bond is stronger than wood itself!

Bond plastic laminates or plywood wall panels with

ELMER'S® CONTACT CEMENT

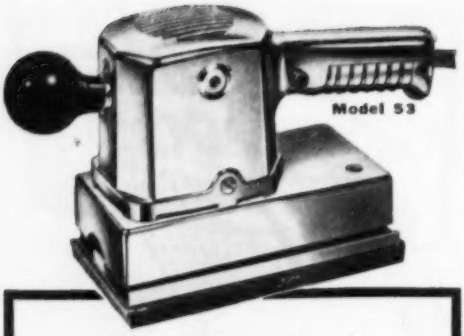
No clamps, nails or presses needed to do professional job quickly. Highly resistant to heat and water. Available in regular or *non-flammable* type to meet every need.

Check ELMER'S Glue Chart for the right glue for the job.

IF IT'S *Borden's*

IT'S GOT TO BE GOOD

The Borden Company, Chemical Division



The Secret of Scratch-free Sanding!

Ask any expert—the secret of a perfect finish is to *sand with the wood grain!* The old-time craftsman did when he sanded by hand. And so do *you*, when you use a Dremel Straight-Line Action Sander—except that a powerful motor does all the work.

With Dremel Straight-Line-Action, you leave no cross-grain scratches or orbital swirl marks to mar the finish of your project. Three models to choose from.

Get a Dremel from your local power tool dealer. If he can't supply you, order direct from factory on 5-DAY TRIAL, money back guarantee. We ship postpaid. Write for free power tool catalog.

DREMEL Straight-Line-Action POWER SANDERS

Model B	$14.85
Model 2000	$19.95
Model 2000 Deluxe kit	$24.80
Model 53	$34.85

DREMEL

DREMEL MFG. CO.
Dept. 127B Racine, Wis.

NEW Govt. Release!
Original Cost
$444.00

HOMELITE "Carryable" GENERATING PLANT

1500 WATT 60 CYCLE, **$189.00**

Single Phase, 115 Vt., A.C.

Carrying handles for easy portability. Fits easily in car trunk

Fully Guaranteed

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[*Continued from page 138*]

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Now Armand has launched another scheme: Eurofima, a central European finance organization which will order, buy and pay for rolling stock which it will then lend to operating networks, thus spreading the capital load and encouraging railway-equipment manufacturers to invest in expensive research to further improve service. Undoubtedly, too, this will further the benefits of Europ, by making for a greater standardization of new equipment.

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FROM the start the railroad user benefits from this new idea in European integration.

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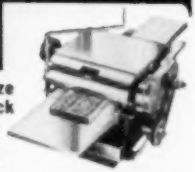

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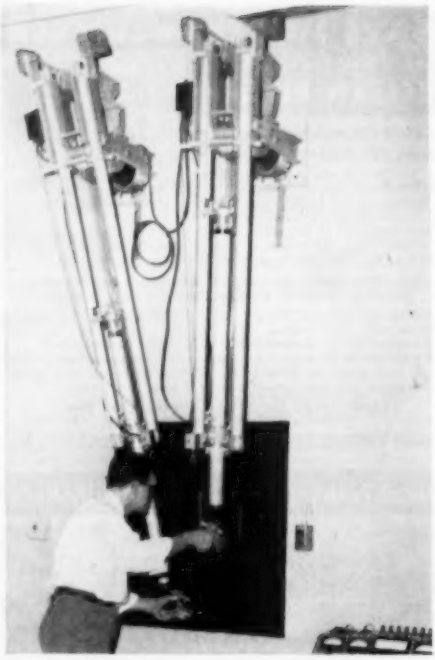

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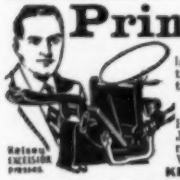

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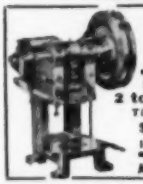

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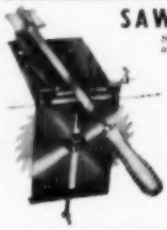

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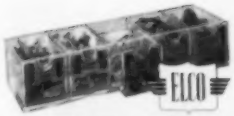

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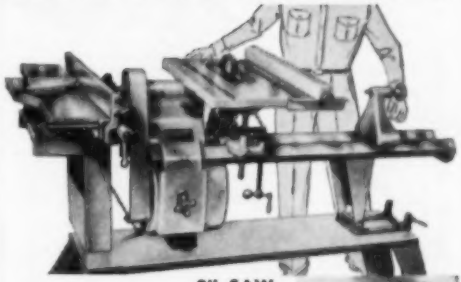

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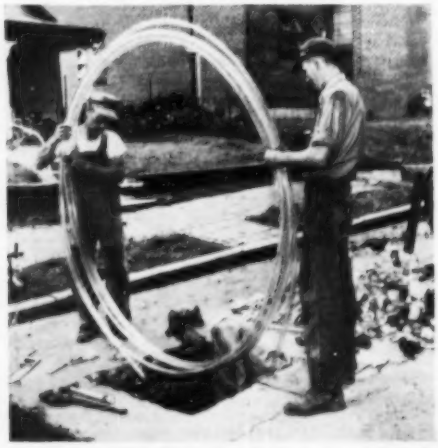
Aircraft Engine Rides Monorail

A 225-FOOT monorail moves engines from the overhaul shop to test cells in five minutes at this San Francisco base. It used to take an hour by crane and tractor. A United Air Lines mechanic holds a switch that will send the engine on its way.

Stationary V-4 Delivers 70 Hp.

THIS big valve-in-head, air-cooled V-4 engine puts out 70 hp. at 3,000 r.p.m. Designed by Avco-Lycoming for on-site installations, the 545-pound package of power will take on chores in industry, on farms and on construction jobs.



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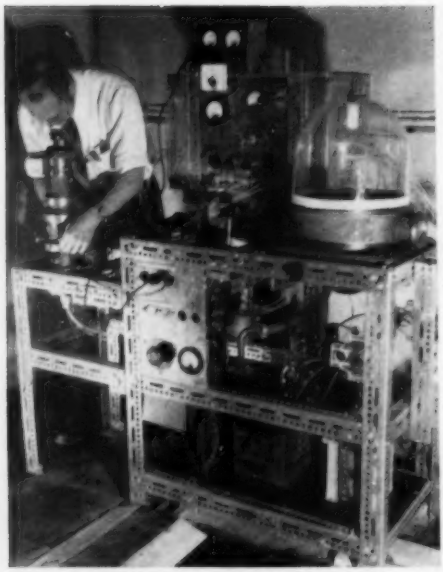

Test Bench Copied from a Toy

A toy construction set gave Sterling Newberry an idea. Using the same kind of perforated "girders," he set up this gadget-loaded electronic test bench in GE's Schenectady engineering laboratory. He now makes changeovers for various experiments in minutes instead of days.

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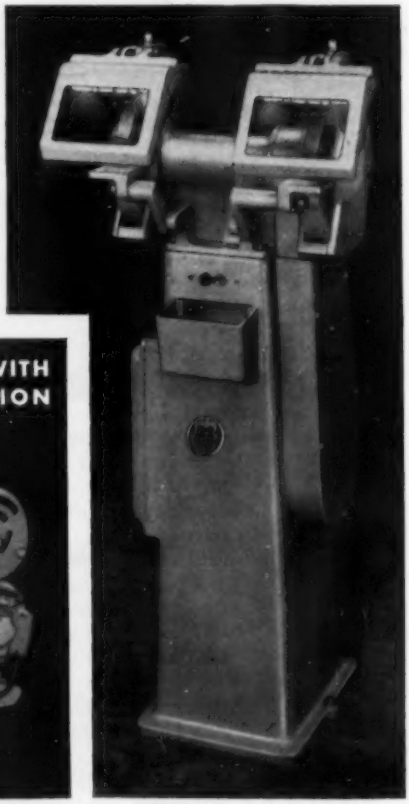

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